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Tsai et al.

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(45) Date of Patent: *Feb. 18, 2014

(54) **WIDE-ANGLE IMAGING LENS ASSEMBLY**

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(73) Assignee: **Largan Precision Co., Ltd.**, Taichung (TW)

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This patent is subject to a terminal disclaimer.

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(51) **Int. Cl.**
G02B 9/60 (2006.01)
G02B 9/34 (2006.01)
G02B 13/04 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 13/04*** (2013.01); ***G02B 9/60*** (2013.01); ***G02B 9/34*** (2013.01)
USPC **359/770**; 359/753; 359/781

(58) **Field of Classification Search**
USPC 359/753, 762, 770, 781
See application file for complete search history.

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Assistant Examiner — Cara Rakowski
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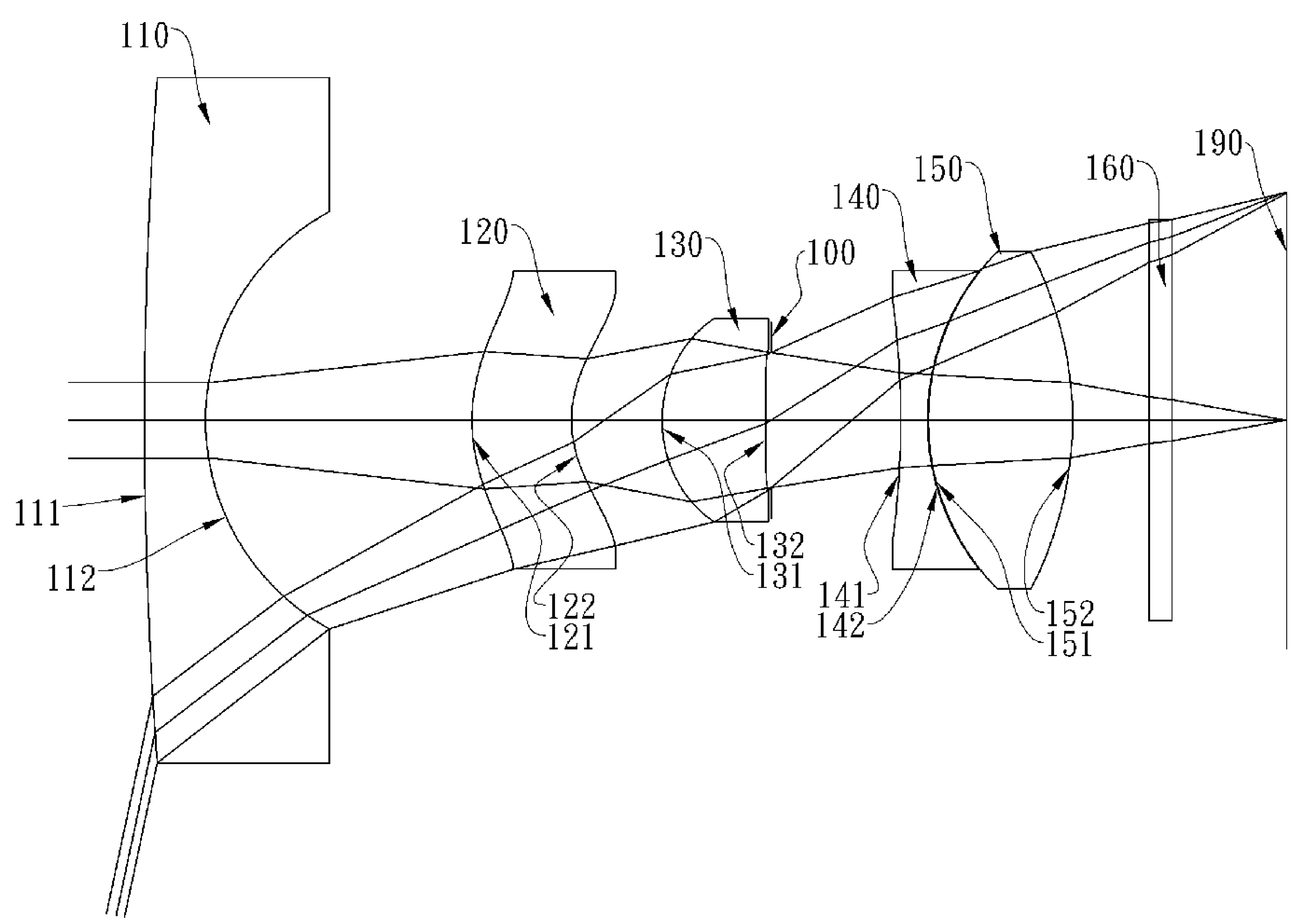
(57) **ABSTRACT**

The present invention provides a wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power having a concave image-side surface; and a fifth lens element with positive refractive power; wherein the two lens elements with refractive power closest to the object side are the first lens element and the second lens element; and wherein the number of lens elements with refractive power does not exceed six.

19 Claims, 36 Drawing Sheets



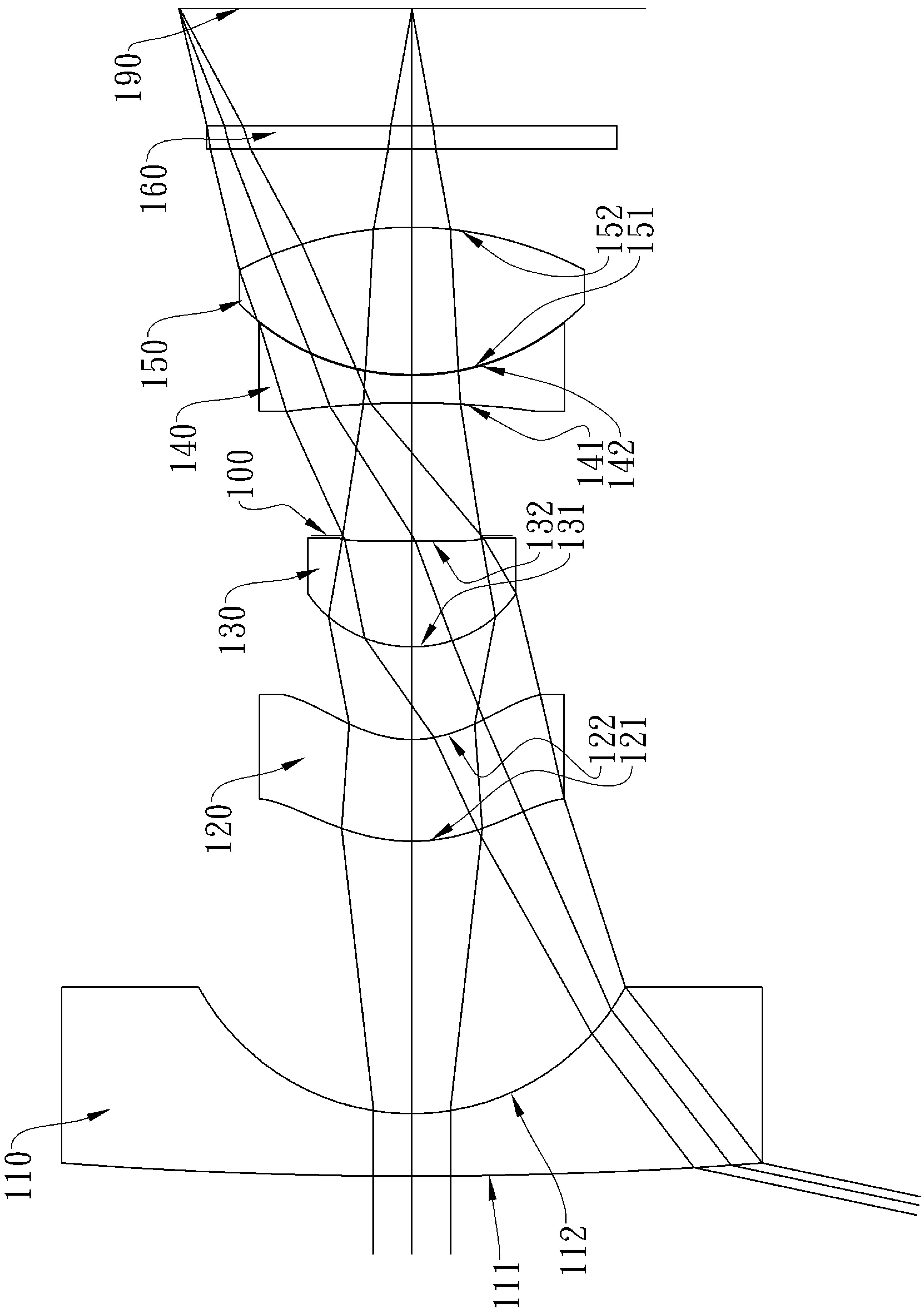

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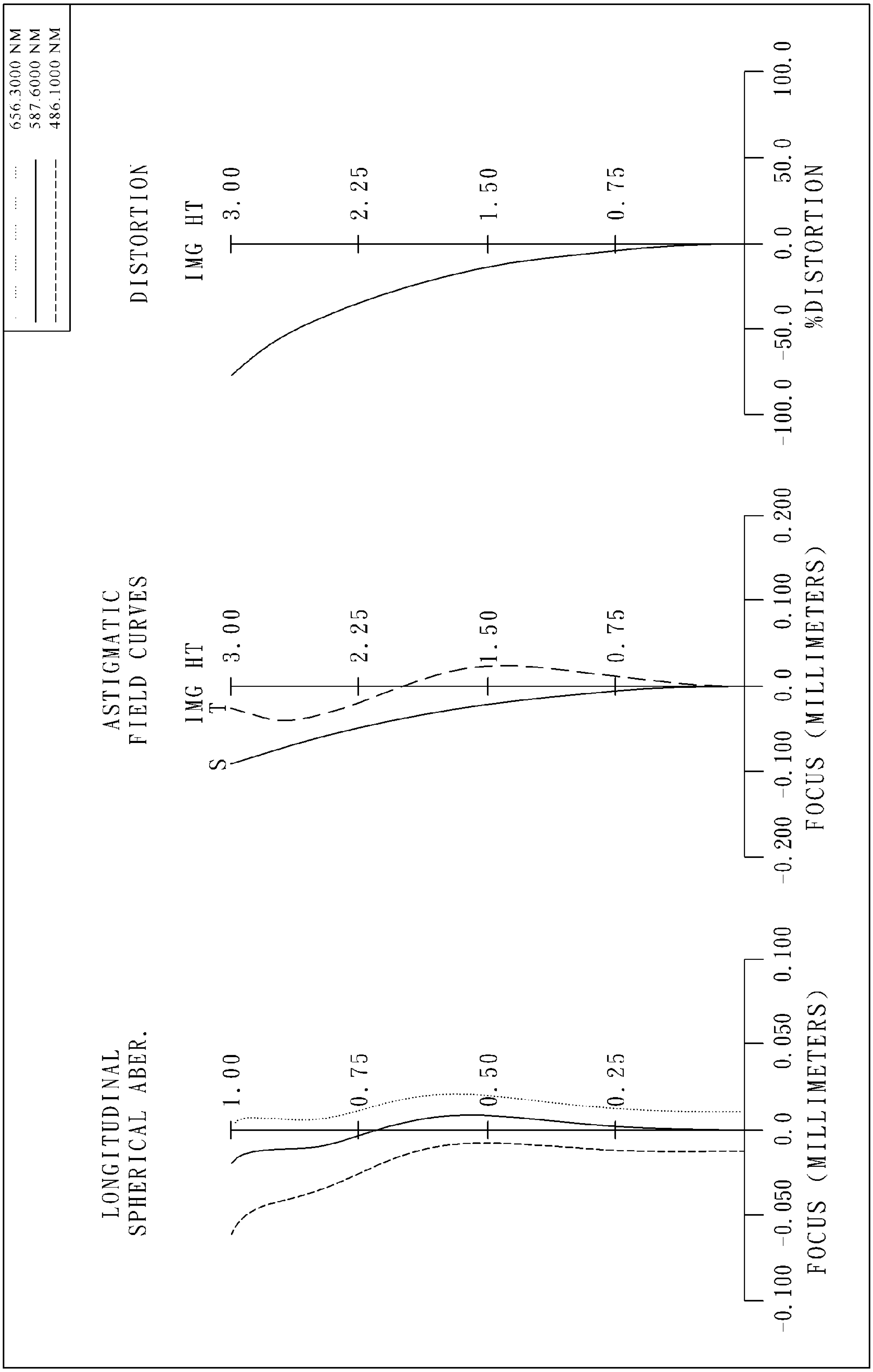
Fig. 1A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ASTIGMATIC
FIELD CURVES
IMG HT
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2.25
1.50
0.75
S
T
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%DISTORTION

Fig. 1B

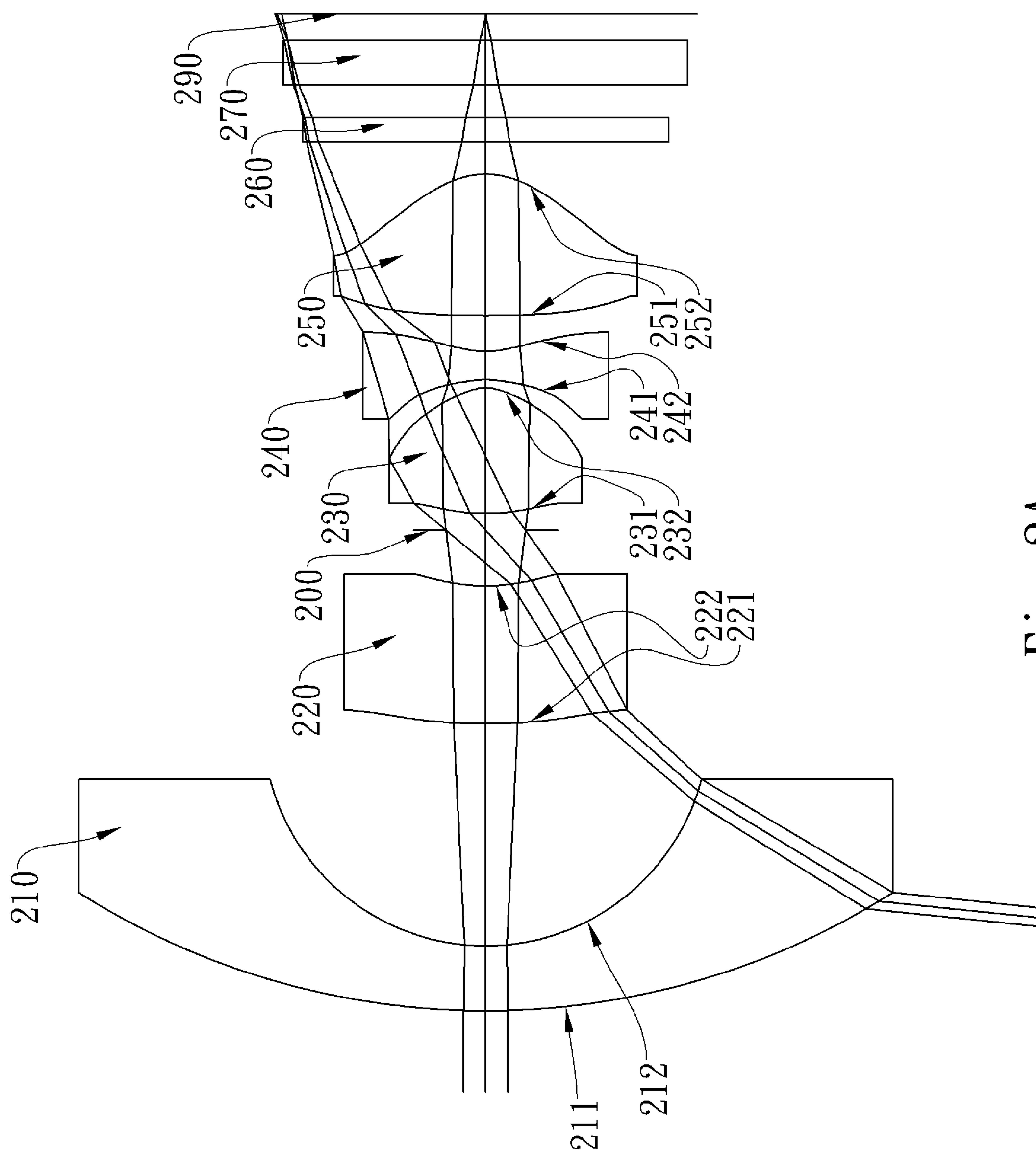
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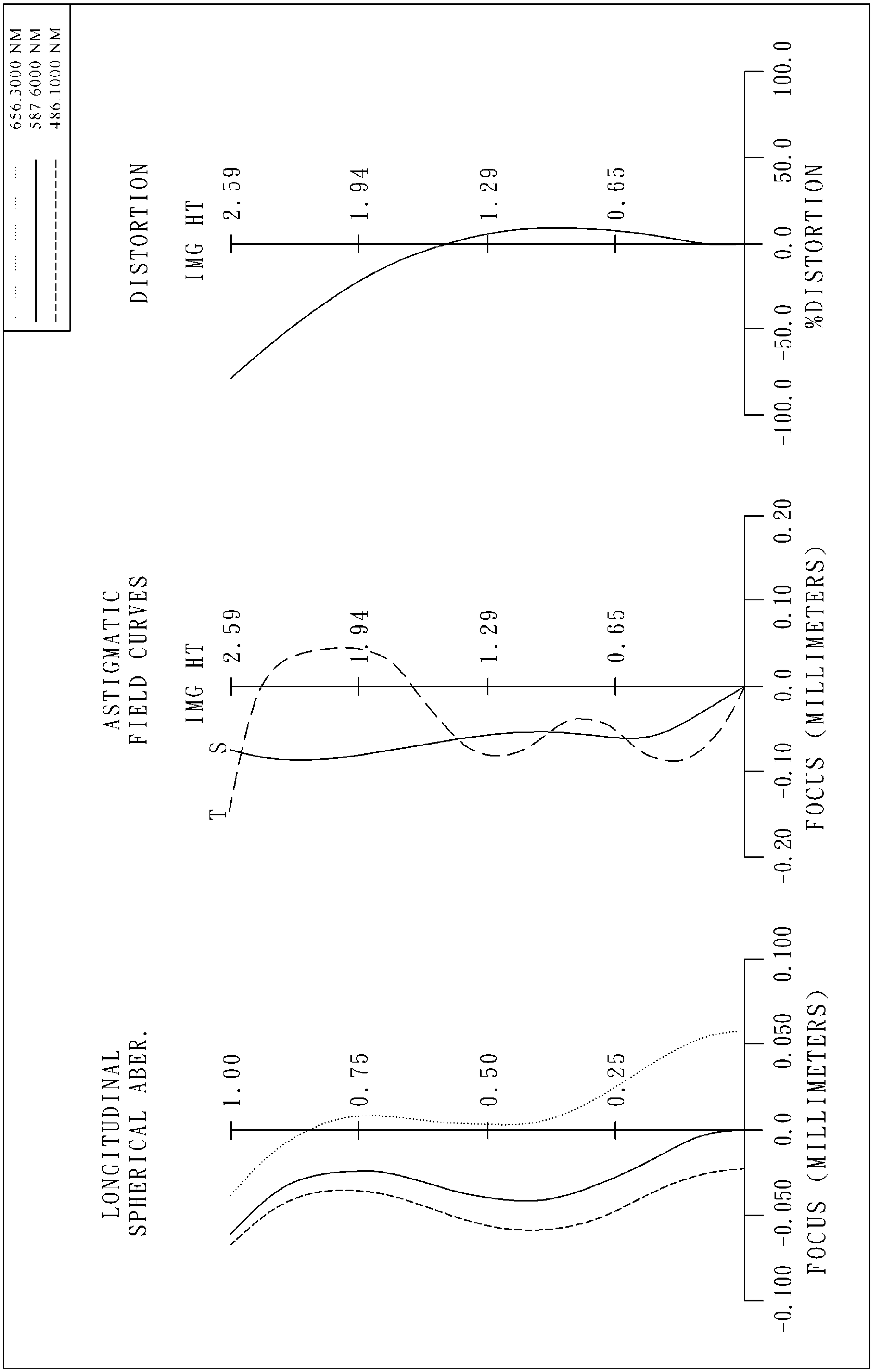
Fig. 2A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1.94
1.29
0.65
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T
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IMG HT
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%DISTORTION

Fig. 2B

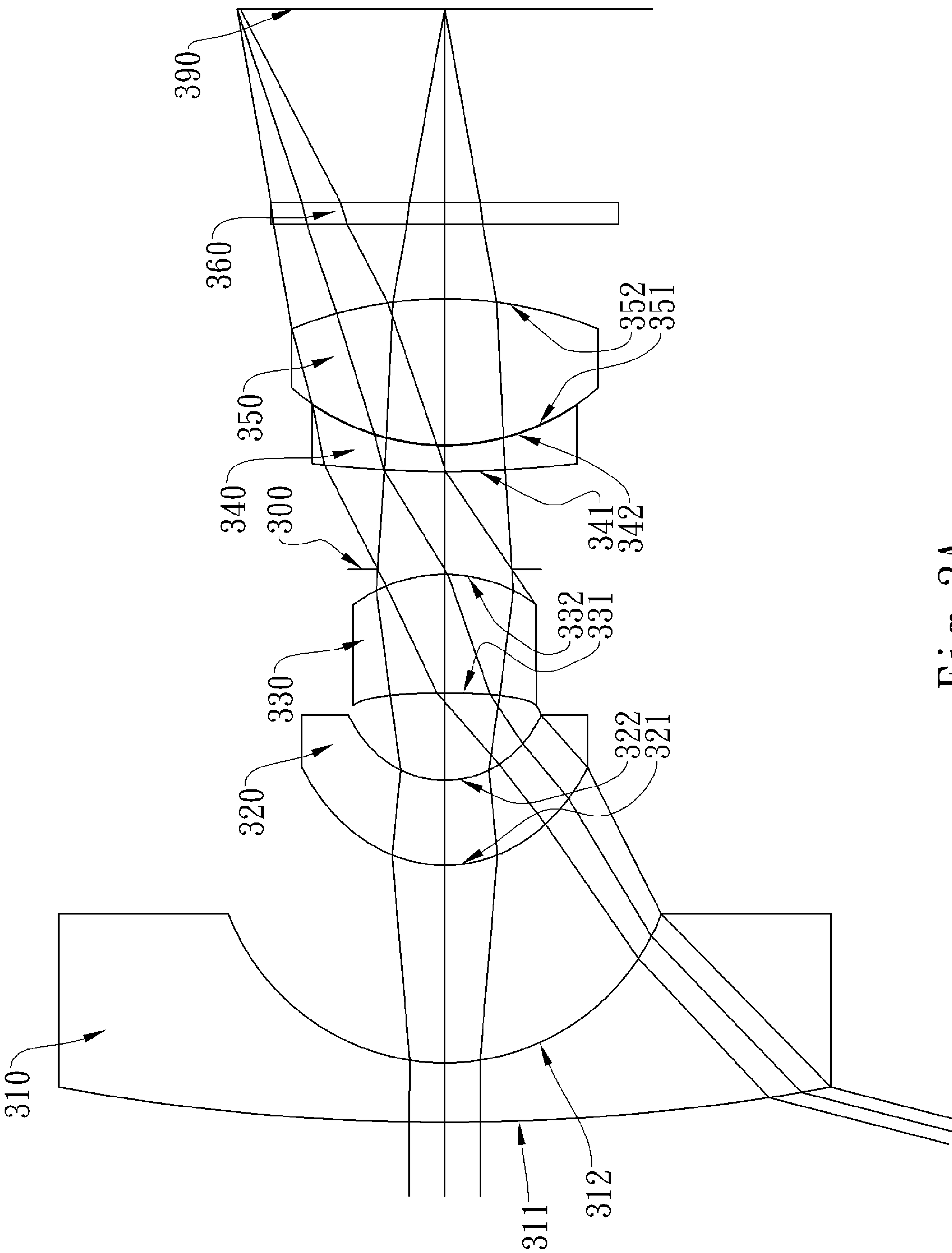

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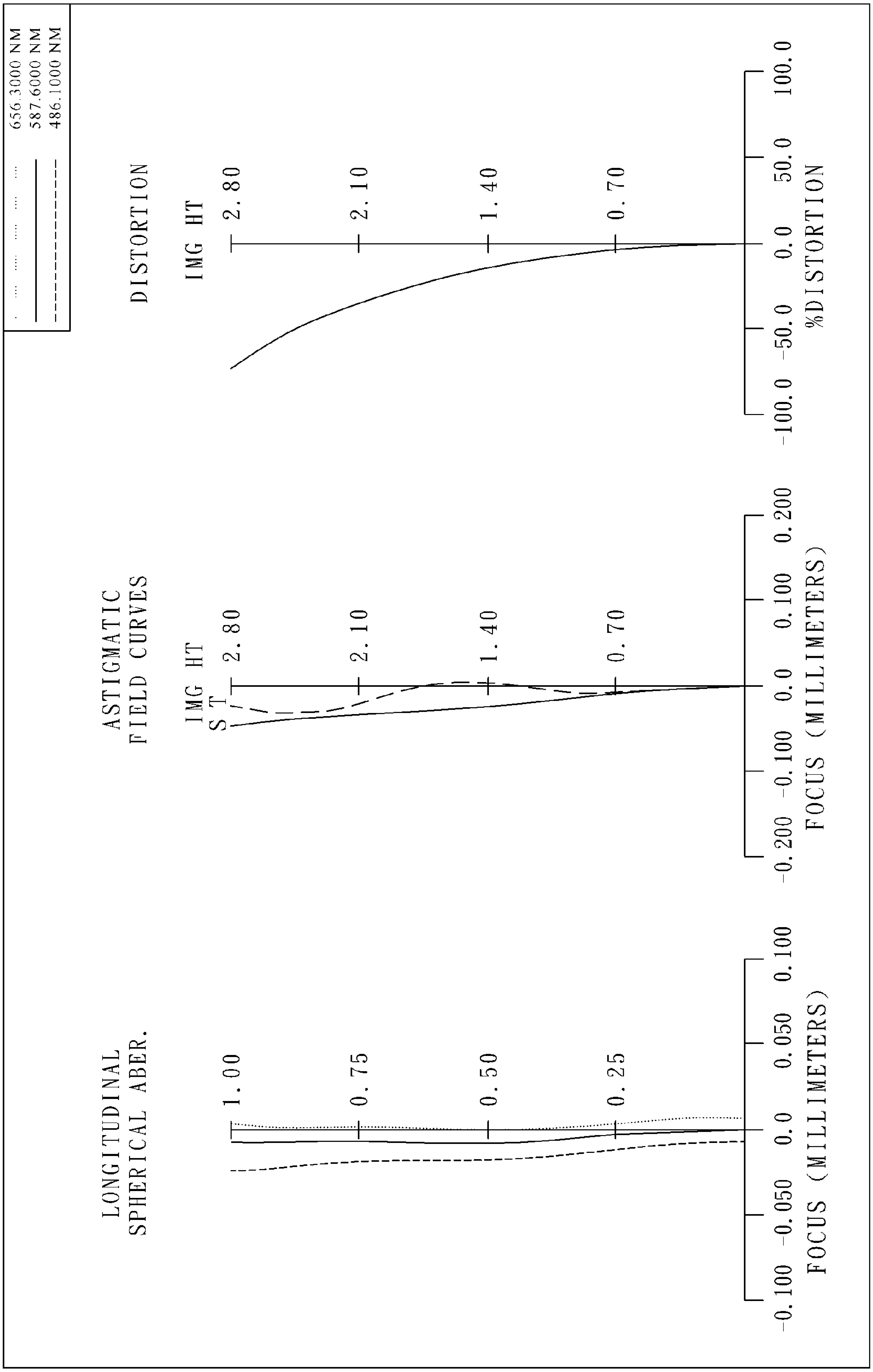
Fig. 3A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%DISTORTION

Fig. 3B

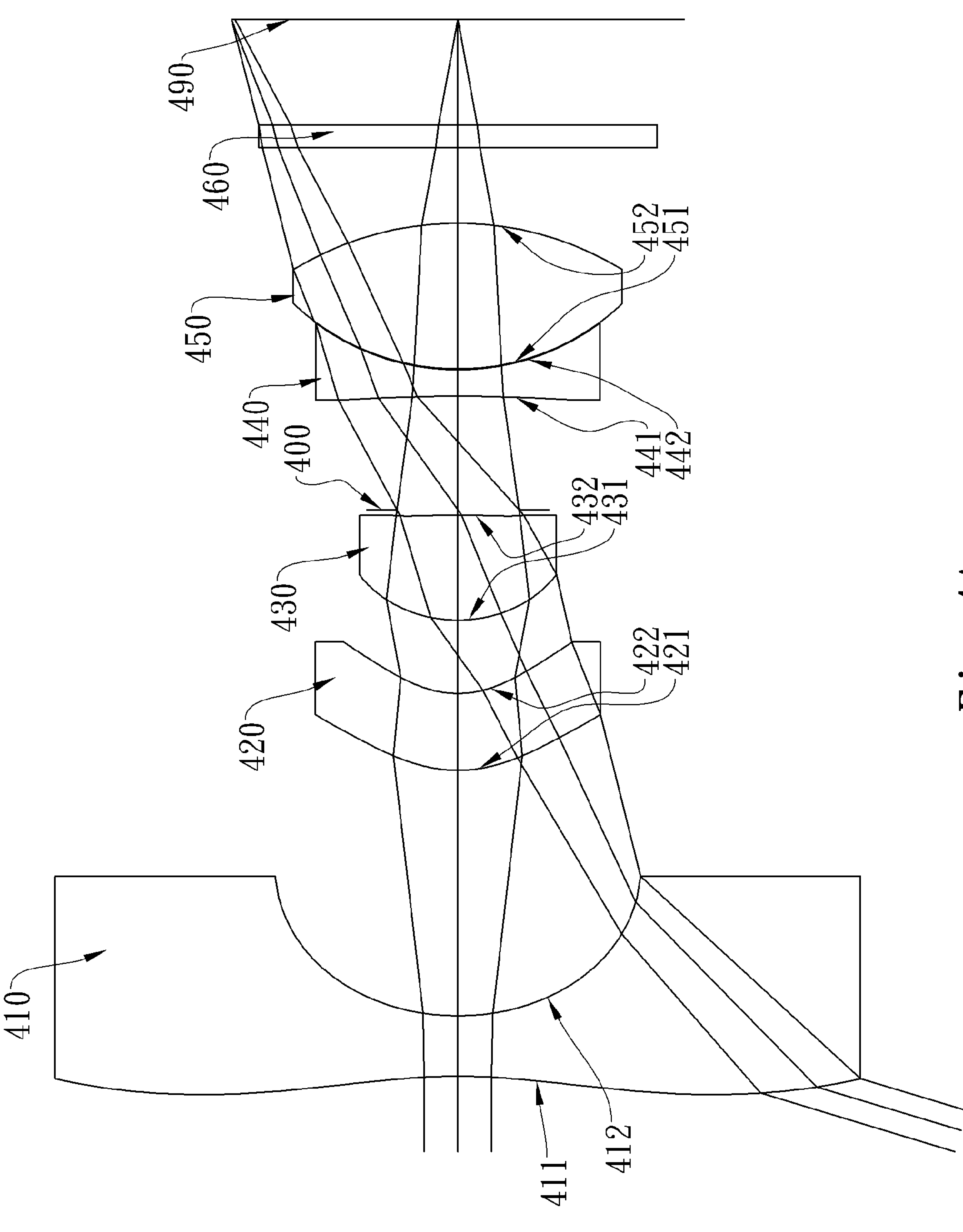
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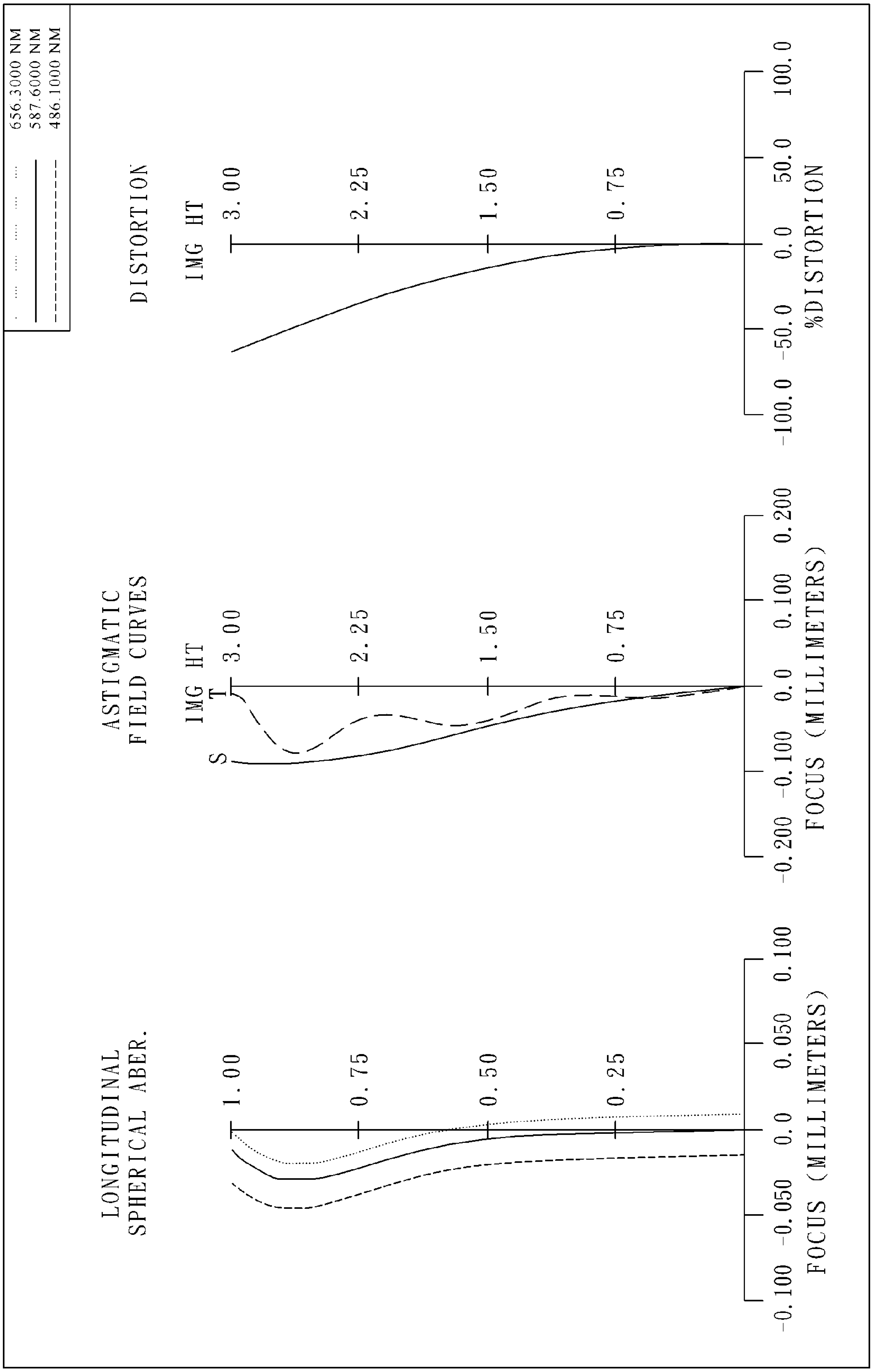
Fig. 4A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0.75
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S
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IMG HT
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%DISTORTION

Fig. 4B

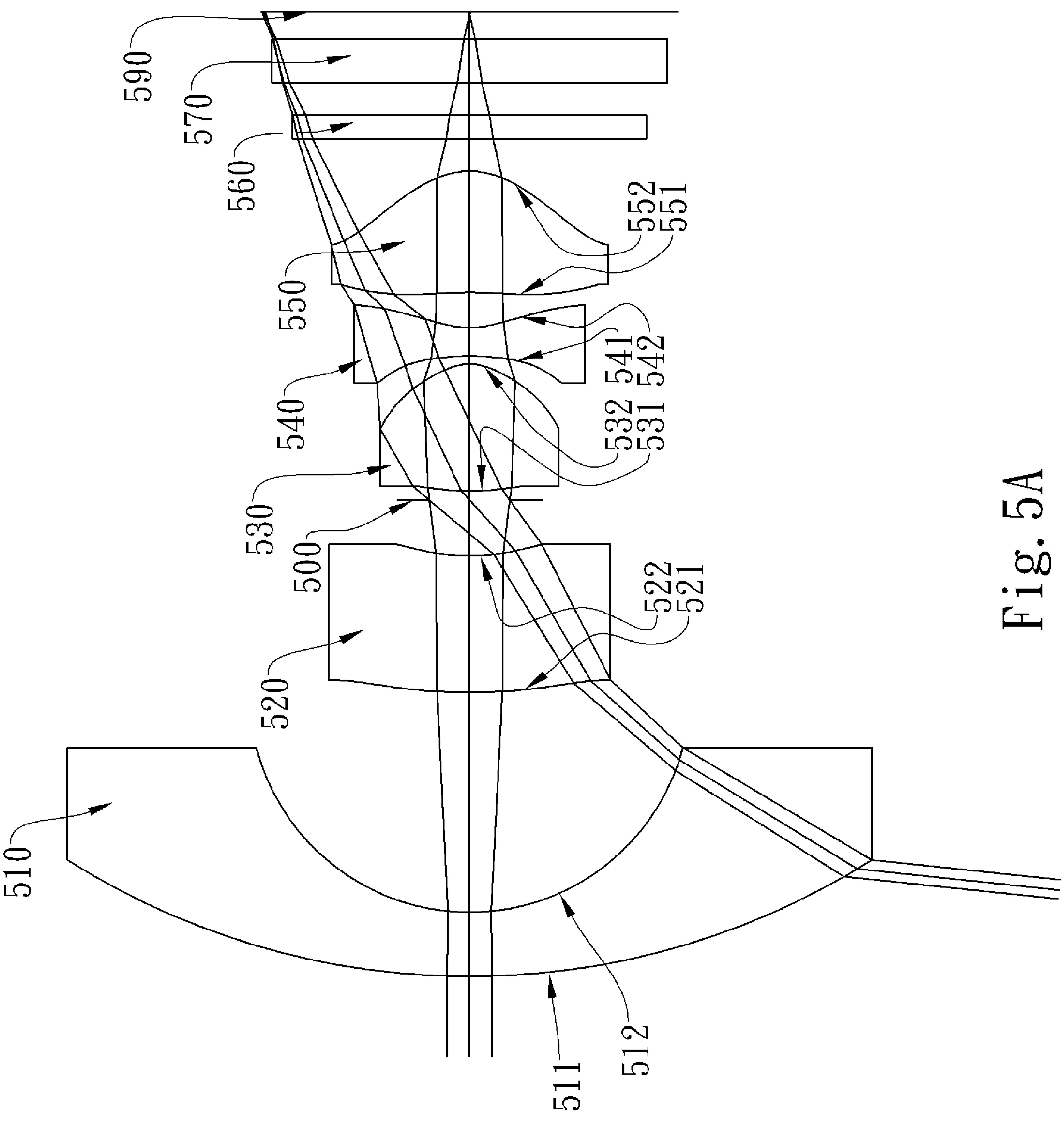
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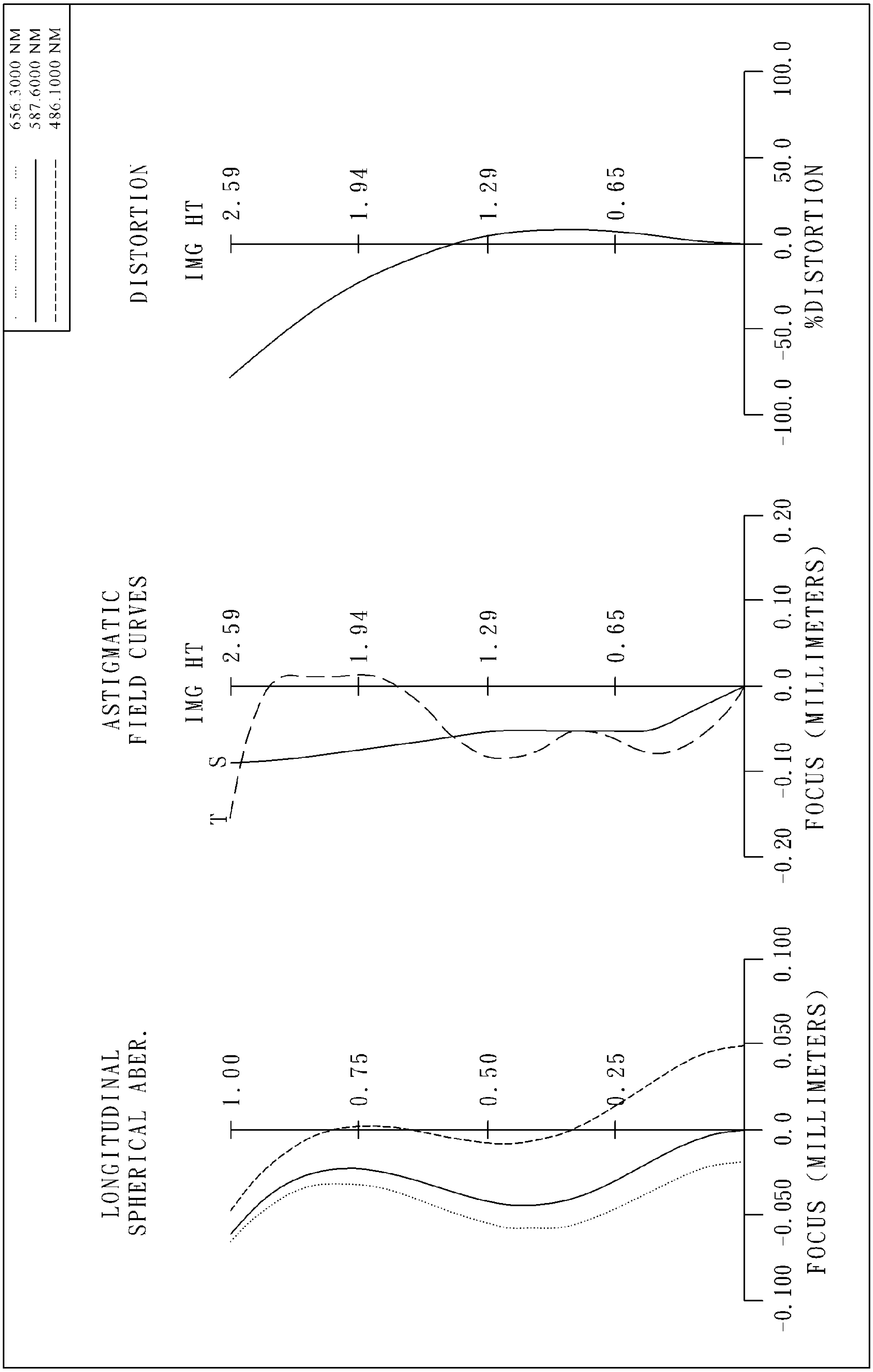
Fig. 5A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IMG HT
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%DISTORTION

Fig. 5B

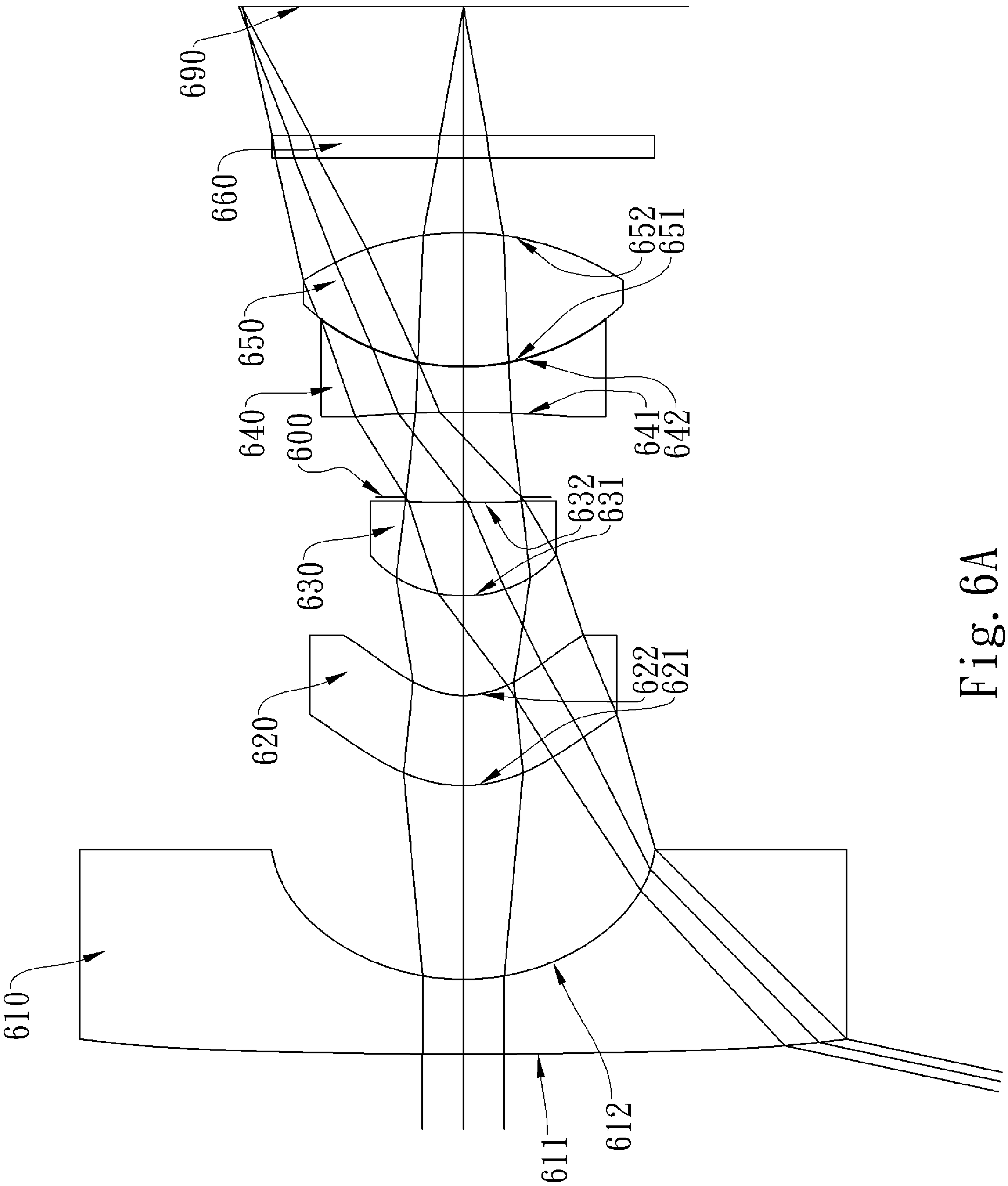
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Fig. 6A

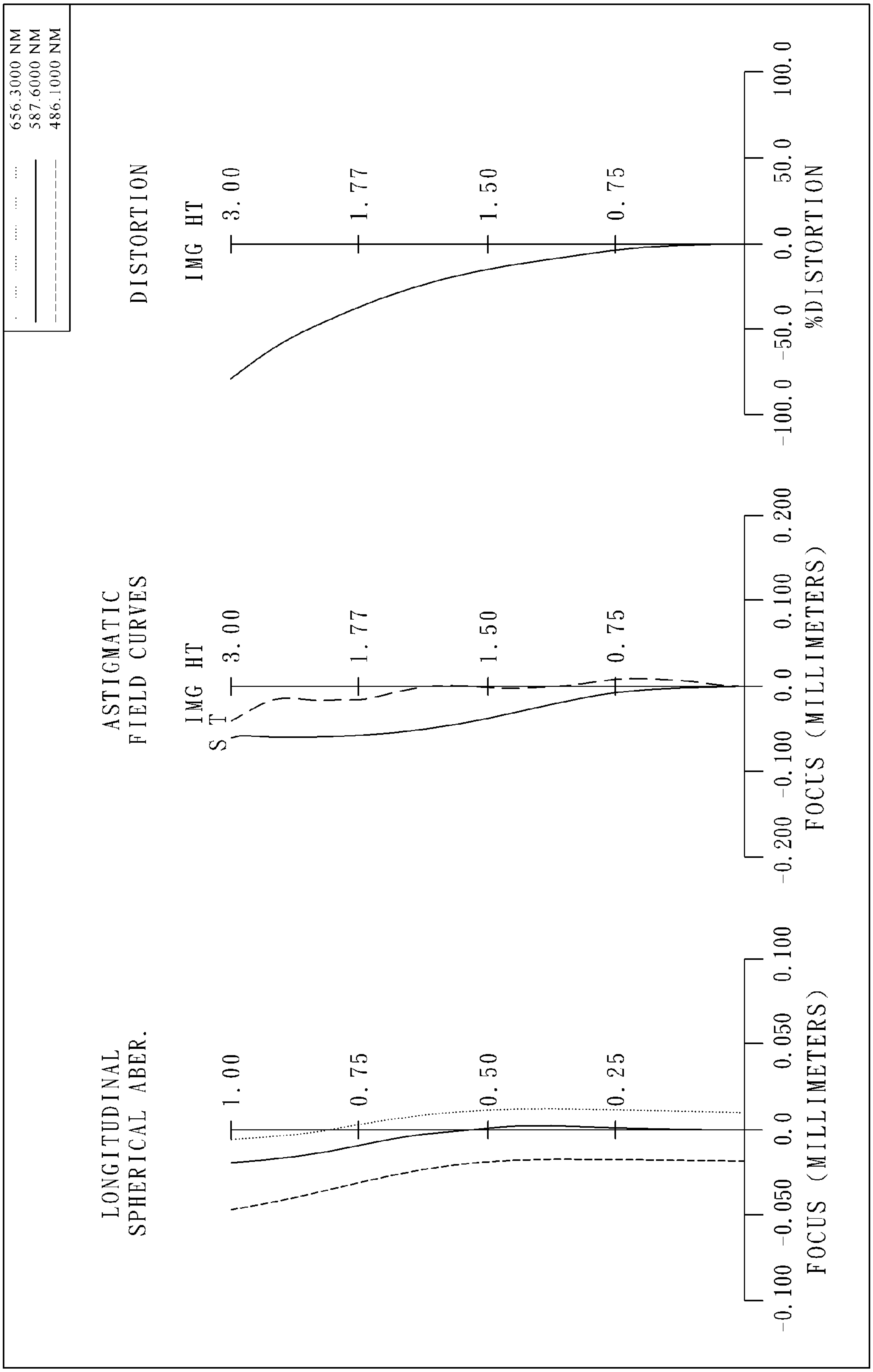
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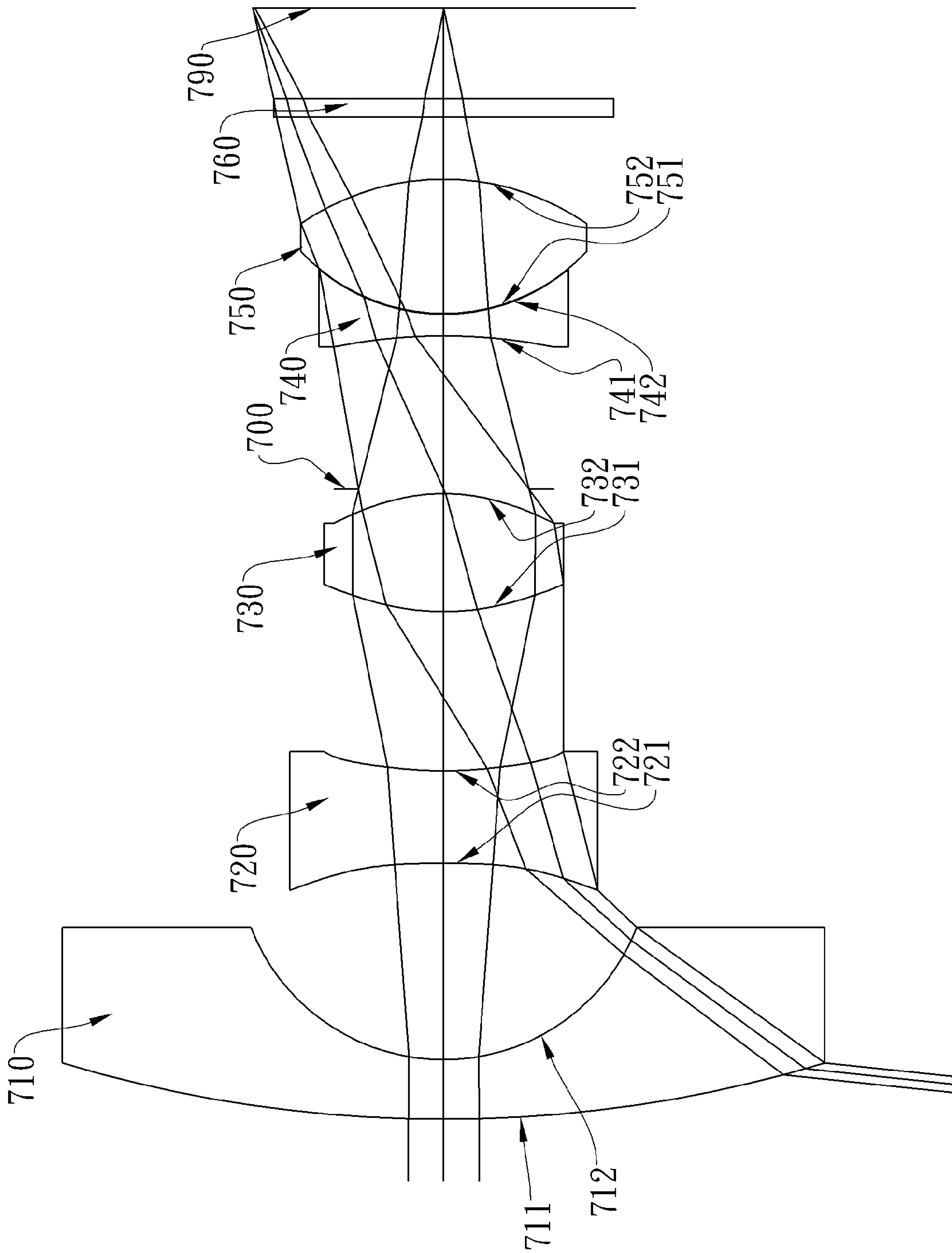
Fig. 6B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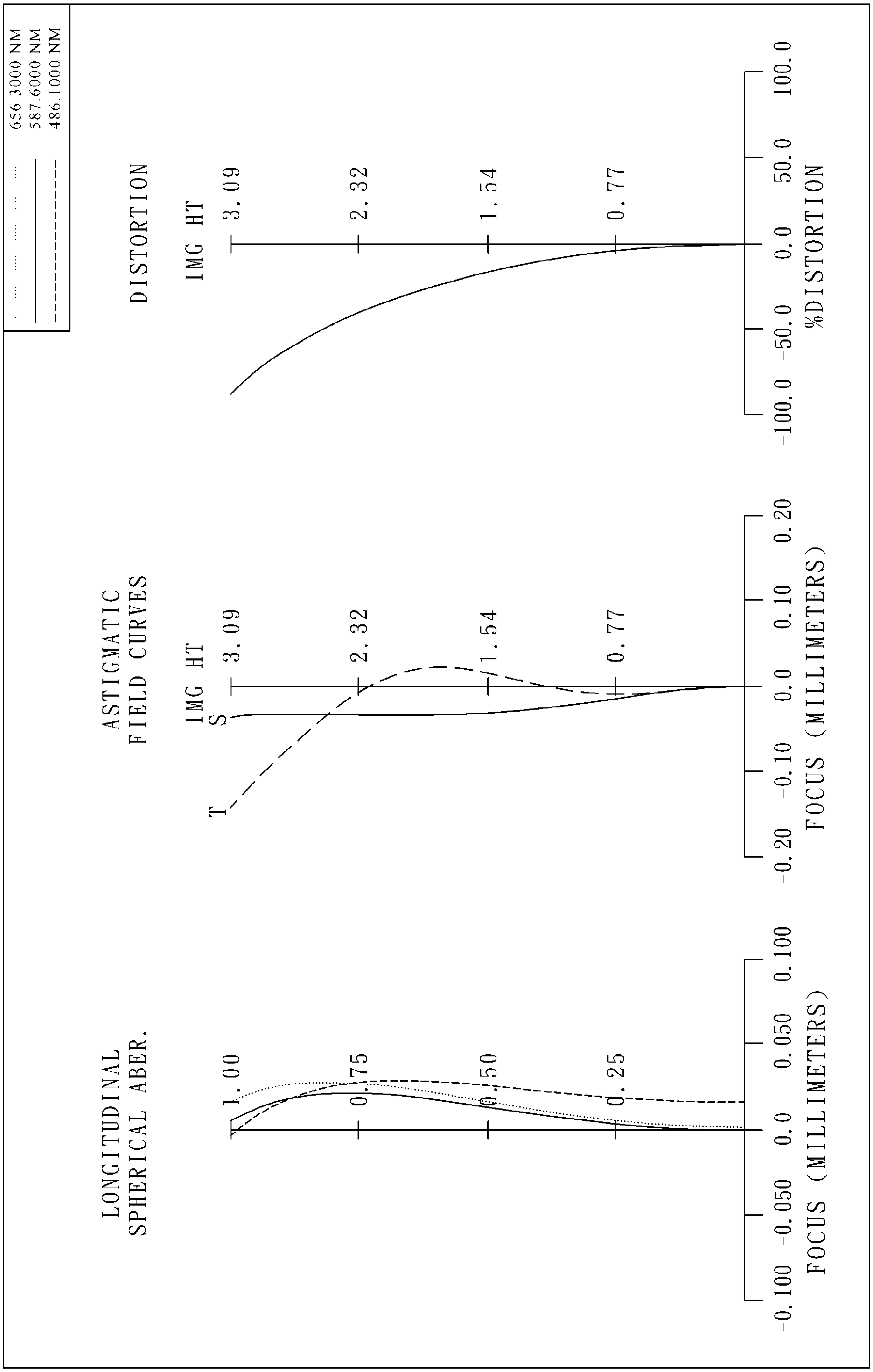
712

Fig. 7A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1.54
0.77
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T
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FOCUS (MILLIMETERS)
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IMG HT
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Fig. 7B

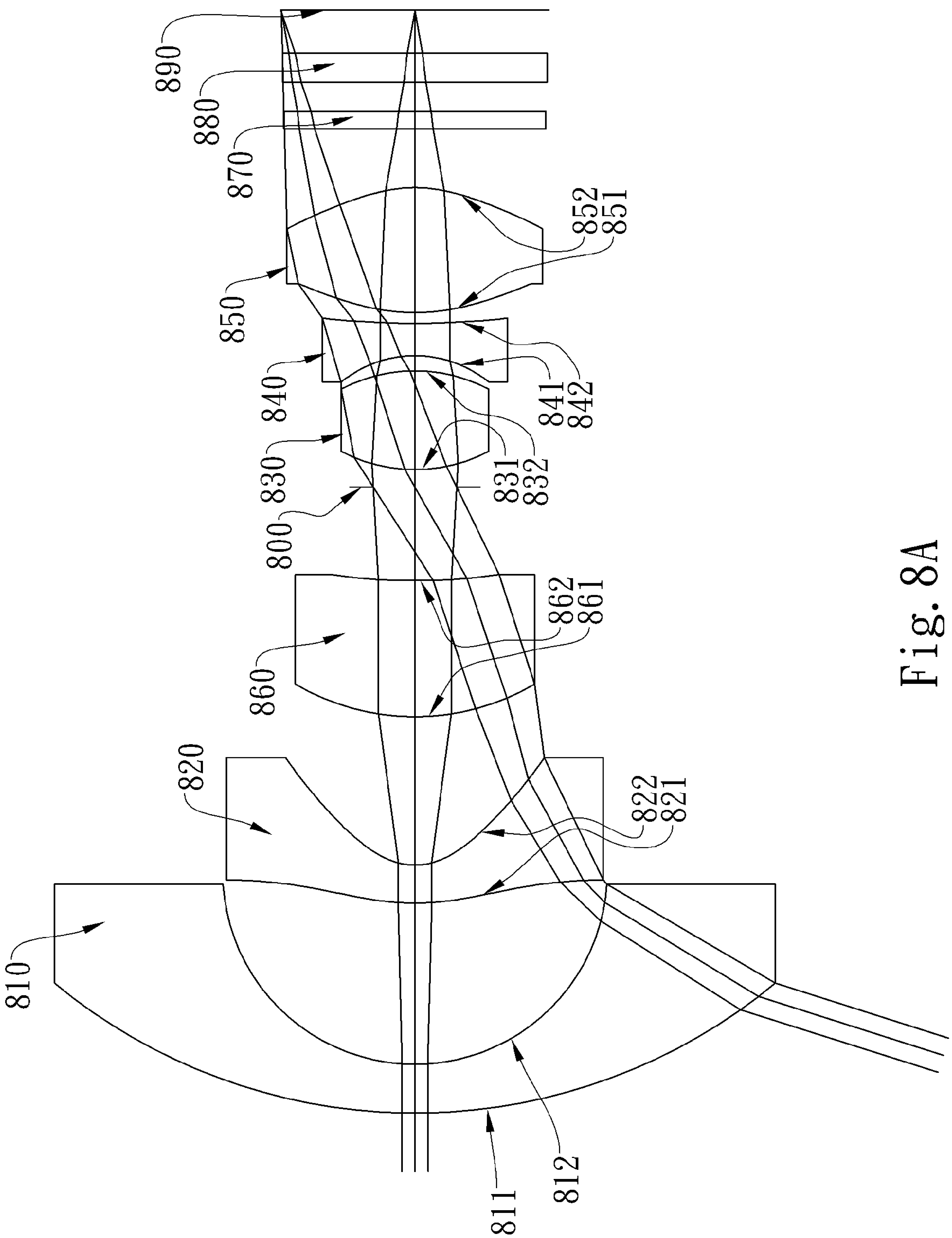
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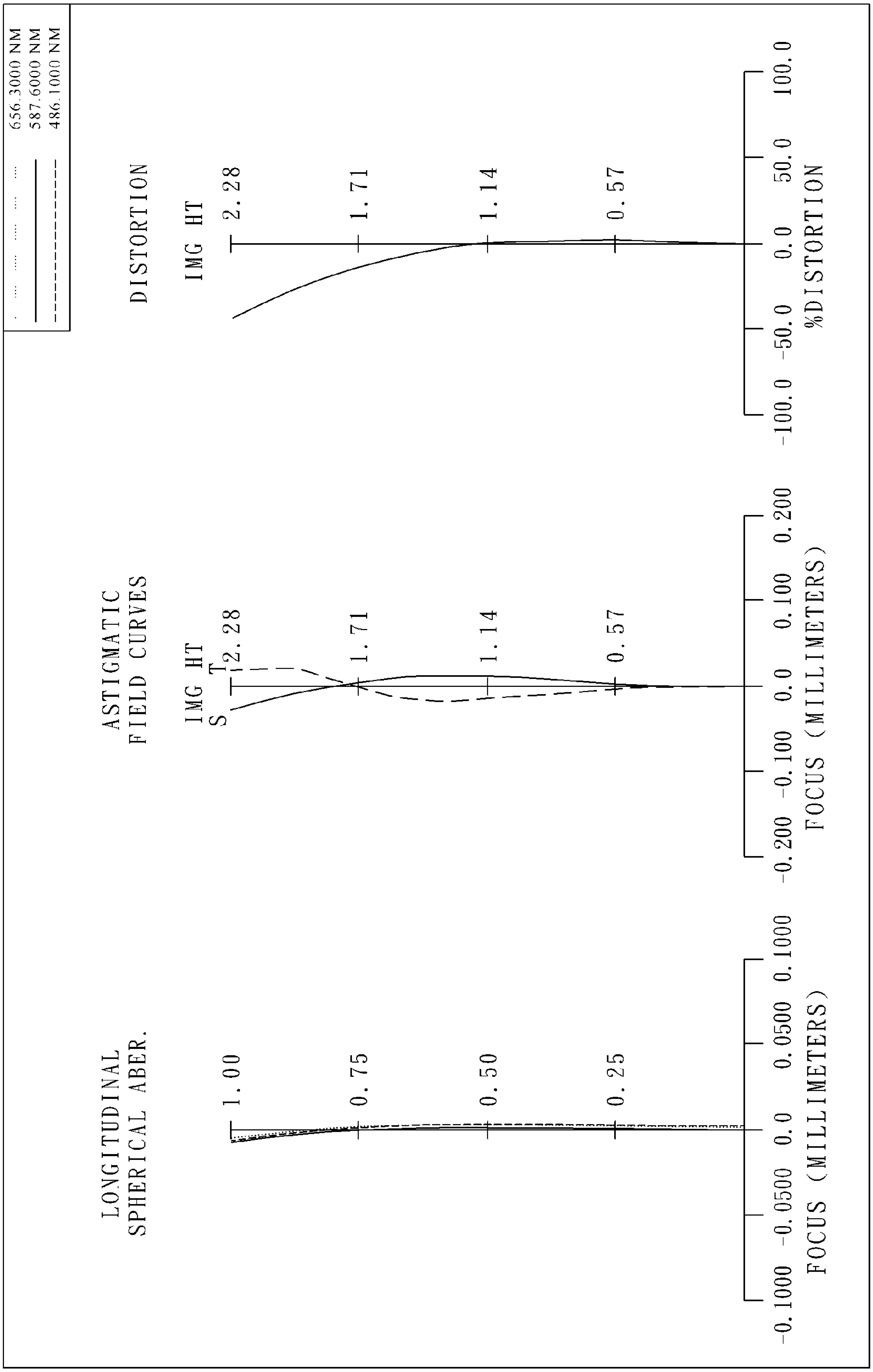
Fig. 8A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ASTIGMATIC FIELD CURVES
IMG HT
S
T
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1.71
1.14
0.57
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FOCUS (MILLIMETERS)
DISTORTION
IMG HT
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%DISTORTION

Fig. 8B

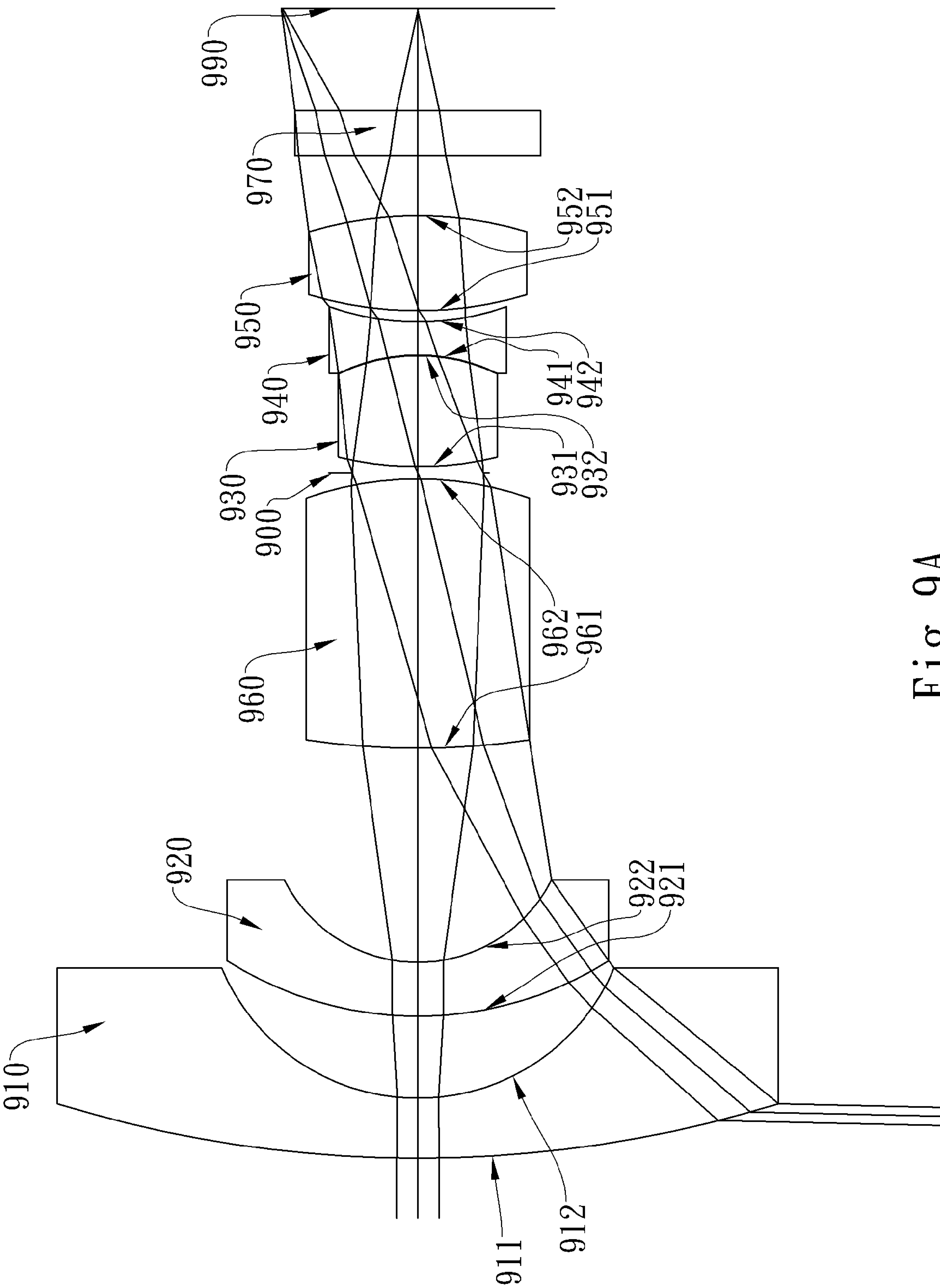
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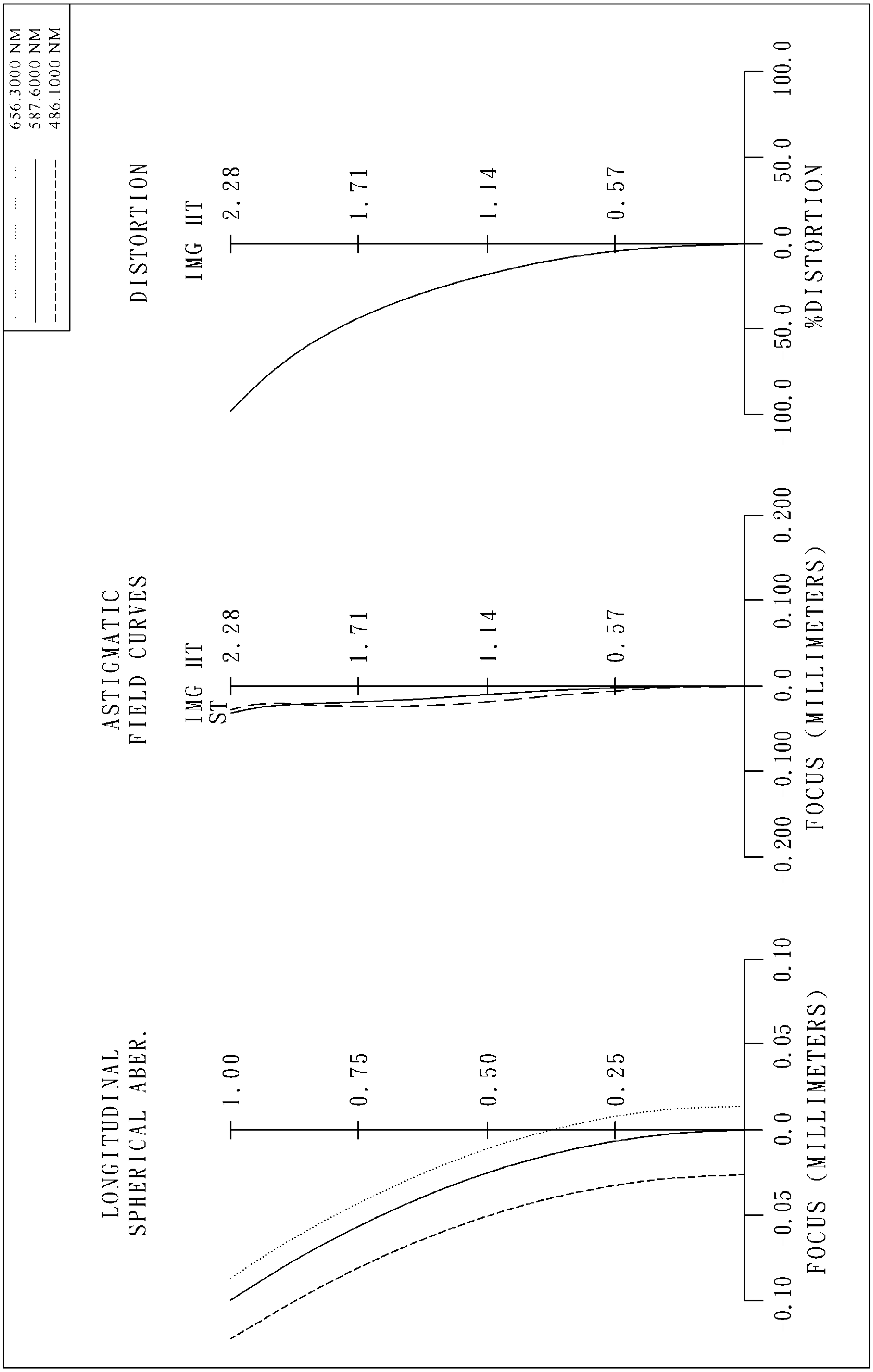
Fig. 9A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0.10
FOCUS (MILLIMETERS)
ASTIGMATIC FIELD CURVES
IMG HT
ST
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1.71
1.14
0.57
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-0.100
0.0
0.100
0.200
FOCUS (MILLIMETERS)
DISTORTION
IMG HT
2.28
1.71
1.14
0.57
-100.0
-50.0
0.0
50.0
100.0
%DISTORTION

Fig. 9B

TABLE 1							
(Embodiment 1)							
f = 2.78 mm, Fno = 2.80, HFOV = 78.0 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	61.349700	0.800	Glass	1.729	54.7	-4.54
2		3.125000	3.500				
3	Lens 2	2.358340 (ASP)	1.307	Plastic	1.650	21.4	-17.39
4		1.525250 (ASP)	1.190				
5	Lens 3	1.698790 (ASP)	1.362	Plastic	1.544	55.9	2.90
6		-16.000000 (ASP)	0.070				
7	Ape. Stop	Plano	1.703				
8	Lens 4	-11.990700	0.350	Glass	1.805	25.4	-3.08
9		3.168400	0.010	Cement			
10	Lens 5	3.168400	1.895	Glass	1.743	49.3	2.85
11		-4.757200	1.000				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	1.511				
14	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.10

TABLE 2				
Aspheric Coefficients				
Surface #	3	4	5	6
k =	-7.68361E-01	-1.67079E+00	2.16182E-01	-1.00000E+00
A4 =	-9.30183E-03	1.60393E-03	-6.53789E-03	5.26641E-02
A6 =	-2.58613E-03	-1.33700E-02	2.20778E-03	2.87669E-02
A8 =	-4.82259E-05	1.01188E-03	-1.74840E-03	-1.75931E-02
A10=	-1.17371E-05	9.42760E-05	5.73103E-04	2.41438E-02

Fig.11

TABLE 3							
(Embodiment 2)							
f = 1.19 mm, Fno = 2.20, HFOV = 84.1 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	9.378300	0.800	Glass	1.729	54.7	-5.62
2		2.749100	2.740				
3	Lens 2	7.462700 (ASP)	1.700	Plastic	1.632	23.4	-6.00
4		2.292880 (ASP)	0.687				
5	Ape. Stop	Plano	0.204				
6	Lens 3	2.173770 (ASP)	1.551	Plastic	1.514	56.8	1.03
7		-0.527000 (ASP)	0.100				
8	Lens 4	-1.295640 (ASP)	0.350	Plastic	1.632	23.4	-0.83
9		0.971220 (ASP)	0.441				
10	Lens 5	14.240800 (ASP)	1.744	Plastic	1.514	56.8	1.84
11		-0.971880 (ASP)	0.400				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	0.400				
14	Cover-glass	Plano	0.550	Glass	1.517	64.2	-
15		Plano	0.330				
16	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.12

TABLE 4

Aspheric Coefficients

Surface #	3	4	6	7
k =	-1.00000E+00	-1.00000E+00	-1.50548E+01	-3.18145E+00
A4 =	2.15032E-02	4.06006E-03	9.16246E-02	1.26996E-01
A6 =	-1.41389E-02	-7.89915E-02	-1.66451E-01	-4.40461E-01
A8 =	2.37398E-03	2.83370E-02	1.13006E-01	3.14951E-01
A10=	-1.50971E-04	1.15143E-02	-8.19772E-02	-9.70404E-02
Surface #	8	9	10	11
k =	-1.84609E+01	-1.17864E+01	-1.23876E+01	-9.23276E-01
A4 =	-4.55397E-02	-4.68630E-02	1.17316E-02	1.05937E-01
A6 =	-1.03519E-01	2.33331E-02	5.20462E-03	-2.76028E-02
A8 =	-2.73802E-02	-1.27404E-02	-2.83293E-03	7.61998E-03
A10=	4.08809E-02	2.83079E-03	4.13162E-04	-5.94489E-04

Fig.13

TABLE 5							
(Embodiment 3)							
f = 2.68 mm, Fno = 2.80, HFOV = 75.5 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	28.836200	0.800	Glass	1.620	60.3	-5.72
2		3.125000	2.662				
3	Lens 2	1.861930 (ASP)	1.143	Plastic	1.634	23.8	-44.97
4		1.331490 (ASP)	1.174				
5	Lens 3	-12.779300 (ASP)	1.597	Plastic	1.544	55.9	4.47
6		-2.134760 (ASP)	0.070				
7	Ape. Stop	Plano	1.318				
8	Lens 4	15.082400	0.350	Glass	1.847	23.8	-4.80
9		3.168400	0.010	Cement			
10	Lens 5	3.168400	1.968	Glass	1.729	54.7	3.04
11		-5.459300	1.000				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	2.607				
14	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.14

TABLE 6				
Aspheric Coefficients				
Surface #	3	4	5	6
k =	-6.65433E-01	-8.28977E-01	9.42693E+01	7.85277E-01
A4 =	5.99846E-03	3.05567E-02	-1.71471E-02	5.93992E-03
A6 =	3.22263E-03	3.50543E-02	-8.44249E-03	2.79810E-03
A8 =	-8.24814E-04	-2.38029E-02	6.28490E-03	-2.16143E-03
A10=	1.73038E-04	1.19166E-02	-4.28271E-03	1.76441E-03

Fig.15

TABLE 7							
(Embodiment 4)							
f = 2.49 mm, Fno = 2.80, HFOV= 73.2 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	-7.332700 (ASP)	0.800	Plastic	1.544	55.9	-3.92
2		3.125000 (ASP)	3.254				
3	Lens 2	1.809440 (ASP)	1.017	Plastic	1.632	23.4	-24.78
4		1.269000 (ASP)	0.971				
5	Lens 3	1.788100 (ASP)	1.392	Plastic	1.544	55.9	2.89
6		-9.410800 (ASP)	0.070				
7	Ape. Stop	Plano	1.506				
8	Lens 4	-25.000000	0.350	Glass	1.847	23.8	-3.30
9		3.168400	0.010	Cement			
10	Lens 5	3.168400	1.933	Glass	1.729	54.7	2.78
11		-4.166900	1.000				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	1.402				
14	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.16

TABLE 8				
Aspheric Coefficients				
Surface #	1	2	3	4
k =	-4.01456E+01	6.57926E-01	-1.06902E+00	-1.57584E+00
A4 =	1.29744E-03	3.76114E-03	-1.49939E-02	-4.20889E-03
A6 =	-1.82927E-05	-9.73854E-04	-2.81411E-03	-1.30040E-02
A8 =	-1.34142E-07	9.64527E-05	1.05085E-04	3.49136E-03
A10=	6.00724E-09	6.31730E-06	1.26023E-04	-4.91232E-05
Surface #	5	6		
k =	3.94699E-01	-1.00000E+00		
A4 =	-9.51701E-03	4.58157E-02		
A6 =	3.33652E-04	2.20684E-02		
A8 =	-9.81509E-04	-1.79062E-02		
A10=	6.06974E-04	2.77312E-02		

Fig.17

TABLE 9							
(Embodiment 5)							
f = 1.23 mm, Fno = 2.20, HFOV= 84.0 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	9.378300	0.800	Glass	1.729	54.7	-5.62
2		2.749100	2.740				
3	Lens 2	7.462700 (ASP)	1.700	Plastic	1.632	23.4	-6.18
4		2.338630 (ASP)	0.698				
5	Ape. Stop	Plano	0.110				
6	Lens 3	2.561640 (ASP)	1.586	Plastic	1.514	56.8	1.07
7		-0.554300 (ASP)	0.100				
8	Lens 4	-2.392830 (ASP)	0.350	Plastic	1.632	23.4	-0.99
9		0.889140 (ASP)	0.441				
10	Lens 5	-5.467600 (ASP)	1.512	Plastic	1.514	56.8	1.98
11		-0.937110 (ASP)	0.400				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	0.400				
14	Cover-glass	Plano	0.550	Glass	1.517	64.2	-
15		Plano	0.335				
16	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.18

TABLE 10				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	-1.00000E+00	-1.00000E+00	-2.18855E+01	-2.99351E+00
A4 =	1.96620E-02	-1.04916E-02	4.01852E-02	5.86584E-02
A6 =	-1.49631E-02	-7.95092E-02	-1.71477E-01	-3.84372E-01
A8 =	2.89728E-03	4.94168E-02	5.79759E-03	3.01808E-01
A10=	-2.17360E-04	-5.91980E-03	-6.18214E-02	-1.11949E-01
Surface #	8	9	10	11
k =	-5.06190E+01	-9.69819E+00	8.90503E+00	-9.13186E-01
A4 =	-4.99342E-02	-3.43643E-02	9.25374E-02	1.08810E-01
A6 =	-1.10175E-01	1.79217E-02	-2.12807E-05	-2.84047E-02
A8 =	1.10155E-03	-1.48471E-02	-1.14647E-02	1.10165E-02
A10=	3.09139E-02	4.06806E-03	2.90352E-03	-1.15642E-03

Fig.19

TABLE 11							
(Embodiment 6)							
f = 3.06 mm, Fno = 2.80, HFOV= 77.8 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	81.300800 (ASP)	1.000	Plastic	1.544	55.9	-6.00
2		3.125000 (ASP)	2.589				
3	Lens 2	1.815820 (ASP)	1.205	Plastic	1.608	25.7	-24.46
4		1.212210 (ASP)	1.330				
5	Lens 3	1.800220 (ASP)	1.249	Plastic	1.544	55.9	3.14
6		-25.865300 (ASP)	0.070				
7	Ape. Stop	Plano	1.138				
8	Lens 4	-17.270500	0.600	Glass	1.805	25.4	-3.28
9		3.168400	0.010	Cement			
10	Lens 5	3.168400	1.788	Glass	1.743	49.3	2.63
11		-3.876200	1.000				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	1.720				
14	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.20

TABLE 12				
Aspheric Coefficients				
Surface #	1	2	3	4
k =	-1.00000E+00	4.63859E-01	-6.89920E-01	-1.54363E+00
A4 =	-1.96787E-04	-2.70500E-03	-1.05526E-02	2.29917E-02
A6 =	1.23634E-05	-2.50617E-04	-1.98219E-03	-1.71357E-02
A8 =	-2.10006E-08	8.10590E-05	-3.17082E-04	6.62918E-04
A10=	-2.70679E-09	-8.88638E-06	6.17313E-05	2.71110E-04
Surface #	5	6		
k =	4.57594E-01	-1.00000E+00		
A4 =	-1.22604E-03	5.59458E-02		
A6 =	-2.65133E-04	1.43612E-02		
A8 =	9.56794E-04	8.17357E-03		
A10=	-6.51768E-04	9.63179E-03		

Fig.21

TABLE 13							
(Embodiment 7)							
f = 2.75 mm, Fno = 2.40, HFOV = 84.0 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	21.411800	0.964	Glass	1.516	64.1	-7.84
2		3.352400	3.182				
3	Lens 2	-19.868500 (ASP)	1.500	Plastic	1.608	25.7	-6.92
4		5.986600 (ASP)	2.577				
5	Lens 3	3.771300 (ASP)	1.913	Plastic	1.544	55.9	3.48
6		-3.116000 (ASP)	0.070				
7	Ape. Stop	Plano	2.487				
8	Lens 4	-8.971900	0.350	Glass	1.805	25.4	-2.73
9		3.168400	0.010	Cement			
10	Lens 5	3.168400	2.179	Glass	1.743	49.3	3.25
11		-4.076200	1.000				
12	IR-filter	Plano	0.300	Glass	1.517	64.2	-
13		Plano	1.469				
14	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.22

TABLE 14

Aspheric Coefficients

Surface #	3	4	5	6
k =	-1.00000E+00	-1.33581E+01	7.98660E-01	-1.00000E+00
A4 =	-1.60168E-02	-1.00310E-02	-9.59491E-03	3.80120E-03
A6 =	1.23146E-03	4.31402E-03	-2.10624E-04	-7.16608E-04
A8 =	1.12209E-04	-8.01564E-04	9.77481E-05	1.61165E-04
A10=	-1.31333E-05	1.80603E-04	-9.01424E-06	-7.47216E-06

Fig.23

TABLE 15							
(Embodiment 8)							
f = 1.27 mm, Fno = 2.82, HFOV = 72.4 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	9.640274	0.833	Glass	1.589	61.3	-8.88
2		3.282339	2.750				
3	Lens 2	4.065613 (ASP)	0.648	Plastic	1.514	56.8	-2.94
4		1.041521 (ASP)	2.534				
5	Lens 6	4.022976	2.319	Glass	1.805	25.5	7.18
6		9.815405	1.598				
7	Ape. Stop	Plano	0.300				
8	Lens 3	2.711143	1.684	Glass	1.497	81.6	3.04
9		-2.711143	0.258				
10	Lens 4	-2.089520 (ASP)	0.550	Plastic	1.608	25.7	-2.68
11		8.183415 (ASP)	0.187				
12	Lens 5	3.241733 (ASP)	2.131	Plastic	1.514	56.8	3.06
13		-2.367229 (ASP)	1.000				
14	IR-filter	Plano	0.300	Glass	1.517	64.2	-
15		Plano	0.500				
16	Cover-glass	Plano	0.500	Glass	1.517	64.2	-
17		Plano	0.731				
18	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.24

TABLE 16				
Aspheric Coefficients				
Surface #	3	4	10	11
k =	0.00000E+00	-8.80033E-01	0.00000E+00	0.00000E+00
A4 =	-1.72398E-02	-4.00151E-02	-3.49476E-02	-3.59021E-02
A6 =	8.60812E-04	-1.46460E-03	2.49829E-02	1.79699E-02
A8 =	-2.32329E-05	1.89733E-04	-6.67513E-03	-3.98152E-03
A10=	1.81977E-07	8.78157E-05	8.52229E-04	4.29390E-04
A12=	-3.65269E-08	-1.36236E-05		
Surface #	12	13		
k =	-1.41292E+00	-2.27025E+00		
A4 =	-9.28158E-03	1.35469E-02		
A6 =	2.31450E-04	-1.99109E-03		
A8 =	6.36181E-04	-1.57283E-04		
A10=	-1.71363E-04	9.15312E-05		
A12=	1.26101E-05	-9.91420E-06		

Fig.25

TABLE 17							
(Embodiment 9)							
f = 1.70 mm, Fno = 2.40, HFOV = 88.7 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal length
0	Object	Plano	Infinity				
1	Lens 1	20.381700	1.000	Glass	1.729	54.7	-6.07
2		3.559000	1.373				
3	Lens 2	5.949500	0.900	Glass	1.729	54.7	-6.64
4		2.500000	3.580				
5	Lens 6	12.846700	4.500	Glass	1.785	25.7	5.50
6		-5.504200	0.100				
7	Ape. Stop	Plano	0.100				
8	Lens 3	5.591300	1.860	Glass	1.697	55.5	3.09
9		-3.017800	0.010				
10	Lens 4	-3.015300	0.550	Glass	1.847	23.8	-2.05
11		4.415300	0.187				
12	Lens 5	6.276000	1.590	Glass	1.804	46.6	4.14
13		-6.276000	1.000				
14	IR-filter	Plano	0.750	Glass	1.517	64.2	-
15		Plano	1.711				
16	Image	Plano	-				
Note：Reference wavelength is d-line 587.6nm							

Fig.26

TABLE 18

	Embodiment 1	Embodiment 2	Embodiment 3	Embodiment 4	Embodiment 5	Embodiment 6	Embodiment 7	Embodiment 8	Embodiment 9
f	2.78	1.19	2.68	2.49	1.23	3.06	2.75	1.27	1.70
Fno	2.80	2.20	2.80	2.80	2.20	2.80	2.40	2.82	2.40
HFOV	78.0	84.1	75.5	73.2	84.0	77.8	84.0	72.4	88.7
V1-V2	33.3	31.3	36.5	32.5	31.3	30.2	42.7	4.5	0.0
f1/f2	0.26	0.94	0.13	0.16	0.91	0.25	1.13	3.02	0.91
R8/R7	-0.26	-0.75	0.21	-0.13	-0.37	-0.18	-0.35	-3.92	-1.46
(R1+R2)/(R1-R2)	1.11	1.83	1.24	0.40	1.83	1.08	1.37	2.03	1.42
T23/T12	0.34	0.33	0.44	0.30	0.29	0.51	0.81	2.45	6.03
CT4/R8	0.11	0.36	0.11	0.11	0.39	0.19	0.11	0.07	0.12
f/ImgH	0.93	0.46	0.96	0.83	0.47	1.02	0.89	0.56	0.75
SL/TTL	0.45	0.51	0.50	0.46	0.49	0.46	0.43	0.42	0.40
TTL/ImgH	4.97	4.63	5.32	4.63	4.53	4.63	5.77	8.14	8.31

Fig.27

WIDE-ANGLE IMAGING LENS ASSEMBLY

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This non-provisional application claims priority under 35 U.S.C. §119(a) on Taiwanese Patent Application No(s). 099131795 filed in Taiwan, R.O.C., on Sep. 20, 2010, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wide-angle imaging lens assembly, and more particularly, to a compact wide-angle imaging lens assembly.

2. Description of the Prior Art

In recent years, optical imaging lenses have been applied to a wide variety of apparatuses such as mobile phone cameras, webcams, automotive lens assemblies, security surveillance cameras and electronic game devices, and the sensor of a general imaging lens is none other than CCD (charge coupled device) or CMOS Sensor (Complementary Metal Oxide Semiconductor Sensor). Furthermore, as advances in semiconductor manufacturing technology have allowed the pixel size of sensors to be reduced and imaging lenses have become more compact with high resolution, there is an increasing demand for imaging lenses featuring better image quality.

Imaging lenses used in vehicle cameras, security surveillance cameras or electronic game devices typically require a larger field of view to capture an image of a larger area at one time. Generally, a conventional imaging lens assembly with a large angle of view, such as the four-element lens assembly disclosed in U.S. Pat. No. 7,446,955, is arranged in such manner that the front lens group has negative refractive power and the rear lens group has positive refractive power, thereby forming an inverse telephoto structure to achieve a large field of view. While such arrangement facilitates the enlargement of the field of view, the aberration correction of the optical system is ineffective due to the inclusion of only one lens element in the rear lens group. Moreover, vehicles equipped with rear-view cameras have become more and more common, and there is a trend toward high-resolution, wide-angle lenses for rear-view cameras. Therefore, a need exists in the art for a wide-angle imaging lens assembly, which has a wide field of view, high image quality and a moderate total track length.

SUMMARY OF THE INVENTION

The present invention provides a wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power having a concave image-side surface; and a fifth lens element with positive refractive power; wherein the two lens elements with refractive power closest to the object side are the first lens element and the second lens element; wherein the number of lens elements with refractive power does not exceed six; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of an object; and wherein a focal length of the first lens element is f**1**, a focal length of the second lens element is f**2**, a distance on an optical axis between the second lens element and the third lens element is T**23**, a distance on the optical axis between the first lens element and the second lens element is T**12**, a radius of curvature of the image-side surface of the fourth lens element is R**8**, a radius of curvature of the object-side surface of the fourth lens element is R**7**, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<f1/f2<2.00$, $0.15<T23/T12<0.69$, $-1.40<R8/R7<0.70$, $0.30<f/ImgH<1.25$.

The present invention provides another wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a concave image-side surface; a second lens element with negative refractive power having a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power; and a fifth lens element with positive refractive power; wherein the wide-angle imaging lens assembly is further provided with a stop and an electronic sensor, the stop is disposed between the second lens element and the fourth lens element, the electronic sensor is disposed at the image plane for image formation of an object; wherein the two lens elements with refractive power closest to the object side are the first lens element and the second lens element; wherein the number of lens elements with refractive power does not exceed six; and wherein a focal length of the first lens element is f**1**, a focal length of the second lens element is f**2**, a distance on an optical axis between the stop and the electronic sensor is SL, a distance on the optical axis between an object-side surface of the first lens element and the electronic sensor is TTL, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<f1/f2<2.00$, $0.20<SL/TTL<0.85$, $TTL/ImgH<8.6$.

The present invention provides yet another wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a concave image-side surface; a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power having a concave image-side surface; and a fifth lens element with positive refractive power; wherein the number of lens elements with refractive power is five; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of an object; and wherein a thickness of the fourth lens element on an optical axis is CT**4**, a radius of curvature of the image-side surface of the fourth lens element is R**8**, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<CT4/R8<0.70$, $0.30<f/ImgH<1.25$.

With the aforementioned arrangement of lens elements, a sufficient field of view can be achieved, the sensitivity of the optical system can be attenuated and the image quality can be improved.

In the present wide-angle imaging lens assembly, the first lens element and the second lens element both have negative refractive power and a concave image-side surface so that the field of view of the optical system can be favorably enlarged. Moreover, the balanced distribution of negative refractive power by the two lens elements with negative refractive power can prevent the aberration of the optical system from increasing excessively. The third lens element has positive refractive power so as to provide part of the refractive power for the optical system and to facilitate the correction of the aberration generated by the first lens element and the second lens element. The fourth lens element has negative refractive power so that the chromatic aberration of the optical system can be favorably corrected. The fifth lens element has positive refractive power so as to effectively distribute the refractive power of the third lens element, thereby facilitating the attenuation of the sensitivity of the optical system.

In the present wide-angle imaging lens assembly, when the first lens element has a convex object-side surface and a concave image-side surface and the second lens element has a convex object-side surface and a concave image-side surface, the field of view of the optical system can be favorably enlarged and the refraction of incident light will become more moderate to prevent the aberration from becoming too large. Accordingly, a balance between enlarging the field of view of the optical system and correcting the aberration can be favorably achieved. When the fourth lens element has a concave object-side surface, the chromatic aberration of the optical system can be favorably corrected. Preferably, the object-side and image-side surfaces of the fourth lens element are both concave. When the fifth lens element has a convex object-side surface and a convex image-side surface, the positive refractive power thereof can be favorably enhanced, thereby the refractive power of the third lens element can be favorably distributed to attenuate the sensitivity of the optical system. Preferably, the fourth lens element and the fifth lens element are attached together to form a doublet lens, which allows the chromatic aberration of the optical system to be corrected more effectively. Preferably, the wide-angle imaging lens assembly further comprises a sixth lens element disposed between any two of the second through fifth lens elements, thereby the high order aberrations of the optical system can be corrected more favorably to improve the image quality.

In the present wide-angle imaging lens assembly, the stop may be disposed between the second lens element and the fourth lens element. For a wide-angle optical system, it requires special effort to correct the distortion and chromatic aberration of magnification, and the correction can be made by placing the stop in a location where the refractive power of the optical system is balanced. Therefore, in the present wide-angle imaging lens assembly, the stop is disposed between the second lens element and the fourth lens element. By arranging at least two lens elements in front of the stop, a sufficient field of view can be achieved. Furthermore, the disposition of at least two lens elements behind the stop facilitates the correction of the aberration of the optical system so that the image quality can be improved. Also, such arrangement of the stop can help attenuate the sensitivity of the optical system.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A shows a wide-angle imaging lens assembly in accordance with the first embodiment of the present invention.

FIG. **1**B shows the aberration curves of the first embodiment of the present invention.

FIG. **2**A shows a wide-angle imaging lens assembly in accordance with the second embodiment of the present invention.

FIG. **2**B shows the aberration curves of the second embodiment of the present invention.

FIG. **3**A shows a wide-angle imaging lens assembly in accordance with the third embodiment of the present invention.

FIG. **3**B shows the aberration curves of the third embodiment of the present invention.

FIG. **4**A shows a wide-angle imaging lens assembly in accordance with the fourth embodiment of the present invention.

FIG. **4**B shows the aberration curves of the fourth embodiment of the present invention.

FIG. **5**A shows a wide-angle imaging lens assembly in accordance with the fifth embodiment of the present invention.

FIG. **5**B shows the aberration curves of the fifth embodiment of the present invention.

FIG. **6**A shows a wide-angle imaging lens assembly in accordance with the sixth embodiment of the present invention.

FIG. **6**B shows the aberration curves of the sixth embodiment of the present invention.

FIG. **7**A shows a wide-angle imaging lens assembly in accordance with the seventh embodiment of the present invention.

FIG. **7**B shows the aberration curves of the seventh embodiment of the present invention.

FIG. **8**A shows a wide-angle imaging lens assembly in accordance with the eighth embodiment of the present invention.

FIG. **8**B shows the aberration curves of the eighth embodiment of the present invention.

FIG. **9**A shows a wide-angle imaging lens assembly in accordance with the ninth embodiment of the present invention.

FIG. **9**B shows the aberration curves of the ninth embodiment of the present invention.

FIG. **10** is TABLE 1 which lists the optical data of the first embodiment.

FIG. **11** is TABLE 2 which lists the aspheric surface data of the first embodiment.

FIG. **12** is TABLE 3 which lists the optical data of the second embodiment.

FIG. **13** is TABLE 4 which lists the aspheric surface data of the second embodiment.

FIG. **14** is TABLE 5 which lists the optical data of the third embodiment.

FIG. **15** is TABLE 6 which lists the aspheric surface data of the third embodiment.

FIG. **16** is TABLE 7 which lists the optical data of the fourth embodiment.

FIG. **17** is TABLE 8 which lists the aspheric surface data of the fourth embodiment.

FIG. **18** is TABLE 9 which lists the optical data of the fifth embodiment.

FIG. **19** is TABLE 10 which lists the aspheric surface data of the fifth embodiment.

FIG. **20** is TABLE 11 which lists the optical data of the sixth embodiment.

FIG. **21** is TABLE 12 which lists the aspheric surface data of the sixth embodiment.

FIG. **22** is TABLE 13 which lists the optical data of the seventh embodiment.

FIG. **23** is TABLE 14 which lists the aspheric surface data of the seventh embodiment.

FIG. **24** is TABLE 15 which lists the optical data of the eighth embodiment.

FIG. **25** is TABLE 16 which lists the aspheric surface data of the eighth embodiment.

FIG. **26** is TABLE 17 which lists the optical data of the ninth embodiment.

FIG. 27 is TABLE 18 which lists the data resulting from the respective equations in accordance with the first through ninth embodiments.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides a wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power having a concave image-side surface; and a fifth lens element with positive refractive power; wherein the two lens elements with refractive power closest to the object side are the first lens element and the second lens element; wherein the number of lens elements with refractive power does not exceed six; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of the object; and wherein a focal length of the first lens element is f1, a focal length of the second lens element is f2, a distance on an optical axis between the second lens element and the third lens element is T23, a distance on the optical axis between the first lens element and the second lens element is T12, a radius of curvature of the image-side surface of the fourth lens element is R8, a radius of curvature of the object-side surface of the fourth lens element is R7, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<f1/f2<2.00$; $0.15<T23/T12<0.69$; $-1.40<R8/R7<0.70$; and $0.30<f/ImgH<1.25$.

When the relation of $0<f1/f2<2.00$ is satisfied, the refractive power of the first lens element and the second lens element can be distributed more appropriately, thereby a wide field of view can be favorably achieved and the aberration of the optical system can be prevented from increasing excessively. Preferably, f1 and f2 satisfy the relation: $0<f1/f2<1.2$. When the relation of $0.15<T23/T12<0.69$ is satisfied, the distance between any two of the first, second and third lens elements is more appropriate, so that it is not too short and makes the assembling process difficult, or too long and affects the size reduction of the lens assembly. When the relation of $-1.40<R8/R7<0.70$ is satisfied, the fourth lens element can provide sufficient negative refractive power, thereby the chromatic aberration of the optical system can be favorably corrected to increase the resolution of the optical system. When the relation of $0.30<f/ImgH<1.25$ is satisfied, a sufficient field of view can be favorably achieved for the wide-angle imaging lens assembly. Preferably, f and ImgH satisfy the relation: $0.40<f/ImgH<1.10$.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the fifth lens element has a convex object-side surface and a convex image-side surface so that the positive refractive power of the fifth lens element can be enhanced, thereby the refractive power of the third lens element can be favorably distributed to attenuate the sensitivity of the optical system.

In the aforementioned wide-angle imaging lens assembly, the radius of curvature of the object-side surface of the first lens element is R1, the radius of curvature of the image-side surface of the first lens element is R2, and they preferably satisfy the relation: $1.03<(R1+R2)/(R1-R2)<3.00$. When the above relation is satisfied, the first lens element can maintain a meniscus shape effectively; this allows the refraction of incident light to be more moderate as the field of view of the optical system is enlarged, thereby preventing the aberration from increasing excessively.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the second lens element is made of plastic material and the surfaces thereof are aspheric.

In the aforementioned wide-angle imaging lens assembly, it is preferable that a stop is disposed between the second lens element and the fourth lens element. The distance on the optical axis between the stop and the electronic sensor is SL, the distance on the optical axis between the object-side surface of the first lens element and the electronic sensor is TTL, and they satisfy the relation: $0.30<SL/TTL<0.65$. When the above relation is satisfied, a balance between miniaturization of the lens assembly and enlarging the field of view of the optical system can be favorably achieved.

Preferably, the aforementioned wide-angle imaging lens assembly comprises at least one aspheric lens element. Aspheric surfaces can be easily made into non-spherical profiles, allowing more design parameter freedom which can be used to reduce aberrations and the number of lens elements. Accordingly, the total track length of the wide-angle imaging lens assembly can be effectively reduced.

In the aforementioned wide-angle imaging lens assembly, the Abbe number of the first lens element is V1, the Abbe number of the second lens element is V2, and they preferably satisfy the relation: $20<V1-V2<50$. When the above relation is satisfied, the wide-angle imaging lens assembly's capability to correct the chromatic aberration can be favorably enhanced.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the number of lens elements with refractive power is five.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the fourth lens element has a concave image-side surface so that the chromatic aberration of the optical system can be favorably corrected.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the fourth lens element and the fifth lens element are adhered together to form a doublet lens element and thereby to correct the chromatic aberration of the optical system more effectively.

In the aforementioned wide-angle imaging lens assembly, the distance on the optical axis between the object-side surface of the first lens element and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they preferably satisfy the relation: $TTL/ImgH<8.6$. Preferably, TTL and ImgH satisfy the relation: $TTL/ImgH<6.0$.

The present invention provides another wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a concave image-side surface; a second lens element with negative refractive power having a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power; and a fifth lens element with positive refractive power; wherein the wide-angle imaging lens assembly is further provided with a stop and an electronic sensor, the stop is disposed between the second lens element and the fourth lens element, the electronic sensor is disposed at the image plane for image formation of an object; wherein the two lens elements with refractive power closest to the object side are the first lens element and the second lens element; wherein the number of lens elements with refractive power does not exceed six; and wherein a focal length of the first lens element is f1, a focal length of the second lens element is f2, a distance on an optical axis between the stop and the electronic sensor is SL, a distance on the optical axis between an object-side surface of the first lens element and the electronic sensor is TTL, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<f1/f2<2.00$, $0.20<SL/TTL<0.85$, $TTL/ImgH<8.6$.

When the relation of $0<f1/f2<2.00$ is satisfied, the refractive power of the first lens element and the second lens element can be distributed more appropriately, thereby a wide field of view can be favorably achieved and the aberration of the optical system can be prevented from increasing excessively. Preferably, f1 and f2 satisfy the relation: $0<f1/f2<1.2$. When the relation of 0.20

$<SL/TTL<0.85$ is satisfied, a balance between miniaturization of the lens assembly and enlarging the field of view of the optical system can be favorably achieved. When the relation of $TTL/ImgH<8.6$ is satisfied, the field of view can be favorably enlarged and the total track length of the lens assembly can be reduced.

In the aforementioned wide-angle imaging lens assembly, the stop is disposed between the second lens element and the fourth lens element. By arranging at least two lens elements with negative refractive power in front of the stop, a sufficient field of view can be achieved for the optical system. Moreover, the disposition of at least two lens elements behind the stop facilitates correcting the aberration of the optical system so that the image quality can be improved. Also, such arrangement of the stop can help attenuate the sensitivity of the optical system.

In the aforementioned wide-angle imaging lens assembly, the two lens elements with refractive power closest to the object side are the first lens element and the second lens element, so that the field of view of the optical system can be favorably enlarged. Moreover, the balanced distribution of negative refractive power by the two lens elements with negative refractive power can prevent the aberration of the optical system from increasing excessively.

In the aforementioned wide-angle imaging lens assembly, the number of lens elements with refractive power does not exceed six. For example, a sixth lens element may be disposed between any two of the second through fifth lens elements so as to favorably correct the high order aberrations of the optical system. Accordingly, the optical system can obtain better image quality.

In the aforementioned wide-angle imaging lens assembly, the radius of curvature of the object-side surface of the first lens element is R1, the radius of curvature of the image-side surface of the first lens element is R2, and they preferably satisfy the relation: $1.03<(R1+R2)/(R1-R2)<3.00$. When the above relation is satisfied, the first lens element can maintain a meniscus shape effectively; this allows the refraction of incident light to be more moderate as the field of view of the optical system is enlarged, thereby preventing the aberration from increasing excessively.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the number of lens elements with refractive power is five.

In the aforementioned wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they preferably satisfy the relation: $0.40<f/ImgH<1.10$. When the above relation is satisfied, a sufficient field of view can be favorably achieved for the wide-angle imaging lens assembly.

In the aforementioned wide-angle imaging lens assembly, the radius of curvature of the image-side surface of the fourth lens element is R8, the radius of curvature of the object-side surface of the fourth lens element is R7, and they preferably satisfy the relation: $-1.40<R8/R7<0.70$. When the above relation is satisfied, the fourth lens element can provide sufficient negative refractive power, thereby favorably correcting the chromatic aberration of the optical system. Accordingly, the resolution of the optical system can be increased.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the object-side and image-side surfaces of the fourth lens element are both concave so that the chromatic aberration of the optical system can be favorably corrected.

The present invention provides yet another wide-angle imaging lens assembly comprising, in order from an object side to an image side: a first lens element with negative refractive power having a concave image-side surface; a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface; a third lens element with positive refractive power; a fourth lens element with negative refractive power having a concave image-side surface; and a fifth lens element with positive refractive power; wherein the number of lens elements with refractive power is five; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of an object; and wherein a thickness of the fourth lens element on an optical axis is CT4, a radius of curvature of the image-side surface of the fourth lens element is R8, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: $0<CT4/R8<0.70$, $0.30<f/ImgH<1.25$.

When the relation of $0<CT4/R8<0.70$ is satisfied, the thickness and curvature of the fourth lens element can be prevented from becoming too large, thereby the image quality can be favorably improved.

In the aforementioned wide-angle imaging lens assembly, the radius of curvature of the object-side surface of the first lens element is R1, the radius of curvature of the image-side surface of the first lens element is R2, and they preferably satisfy the relation: $1.03<(R1+R2)/(R1-R2)<3.00$. When the above relation is satisfied, the first lens element can maintain a meniscus shape effectively; this allows the refraction of incident light to be more moderate as the field of view of the optical system is enlarged, thereby preventing the aberration from increasing excessively.

In the aforementioned wide-angle imaging lens assembly, the focal length of the first lens element is f1, the focal length of the second lens element is f2, and they preferably satisfy the relation: $0<f1/f2<1.20$. When the above relation is satisfied, the refractive power of the first lens element and the second lens element can be distributed more appropriately, thereby a wide field of view can be favorably achieved and the aberration of the optical system can be prevented from increasing excessively.

In the aforementioned wide-angle imaging lens assembly, it is preferable that the fourth lens element has a concave object-side surface so that the chromatic aberration of the optical system can be favorably corrected.

In the present wide-angle imaging lens assembly, the lens elements can be made of glass or plastic material. If the lens elements are made of glass, there is more freedom in distributing the refractive power of the optical system. If plastic material is adopted to produce the lens elements, the production cost will be reduced effectively.

In the present wide-angle imaging lens assembly, if a lens element has a convex surface, it means the portion of the surface in proximity to the optical axis is convex; if a lens element has a concave surface, it means the portion of the surface in proximity to the optical axis is concave.

Preferred embodiments of the present invention will be described in the following paragraphs by referring to the accompanying drawings.

FIG. **1**A shows a wide-angle imaging lens assembly in accordance with the first embodiment of the present invention, and FIG. **1**B shows the aberration curves of the first embodiment of the present invention. In the first embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a glass first lens element **110** with negative refractive power having a convex object-side surface **111** and a concave image-side surface **112**; a plastic second lens element **120** with negative refractive power having a convex object-side surface **121** and a concave image-side surface **122**, the object-side and image-side surfaces **121** and **122** thereof being aspheric; a plastic third lens element **130** with positive refractive power having a convex object-side surface **131** and a convex image-side surface **132**, the object-side and image-side surfaces **131** and **132** thereof being aspheric; a glass fourth lens element **140** with negative refractive power having a concave object-side surface **141** and a concave image-side surface **142**; and a glass fifth lens element **150** with positive refractive power having a convex object-side surface **151** and a convex image-side surface **152**; wherein the fourth lens element **140** and the fifth lens element **150** are adhered together to form a doublet lens. Moreover, the wide-angle imaging lens assembly is provided with a stop **100** and an electronic sensor, the stop **100** is disposed between the third lens element **130** and the fourth lens element **140**, the electronic sensor is disposed at the image plane **190** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **160** disposed between the image-side surface **152** of the fifth lens element **150** and the image plane **190**; the IR-filter **160** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles is expressed as follows:

$$X(Y) = (Y^2/R)/(1+sqrt(1-(1+k)*(Y/R)^2)) + \sum_i (Ai)*(Y^i)$$

wherein:

X: the height of a point on the aspheric surface at a distance Y from the optical axis relative to the tangential plane at the aspheric surface vertex;

Y: the distance from the point on the curve of the aspheric surface to the optical axis;

k: the conic coefficient;

Ai: the aspheric coefficient of order i.

In the first embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=2.78 (mm).

In the first embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.80.

In the first embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=78.0 deg.

In the first embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **110** is V**1**, the Abbe number of the second lens element **120** is V**2**, and they satisfy the relation: V**1**−V**2**=33.3.

In the first embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **110** is f**1**, the focal length of the second lens element **120** is f**2**, and they satisfy the relation: f**1**/f**2**=0.26.

In the first embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **142** of the fourth lens element **140** is R**8**, the radius of curvature of the object-side surface **141** of the fourth lens element **140** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.26. In the first embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **111** of the first lens element **110** is R**1**, the radius of curvature of the image-side surface **112** of the first lens element **110** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.11.

In the first embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **120** and the third lens element **130** is T**23**, the distance on the optical axis between the first lens element **110** and the second lens element **120** is T**12**, and they satisfy the relation: T**23**/T**12**=0.34.

In the first embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **140** on the optical axis is CT**4**, the radius of curvature of the image-side surface **142** of the fourth lens element **140** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.11.

In the first embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.93.

In the first embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **100** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **111** of the first lens element **110** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.45, TTL/ImgH=4.97.

The detailed optical data of the first embodiment is shown in FIG. **10** (TABLE 1), and the aspheric surface data is shown in FIG. **11** (TABLE 2), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **2**A shows a wide-angle imaging lens assembly in accordance with the second embodiment of the present invention, and FIG. **2**B shows the aberration curves of the second embodiment of the present invention. In the second embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a glass first lens element **210** with negative refractive power having a convex object-side surface **211** and a concave image-side surface **212**; a plastic second lens element **220** with negative refractive power having a convex object-side surface **221** and a concave image-side surface **222**, the object-side and image-side surfaces **221** and **222** thereof being aspheric; a plastic third lens element **230** with positive refractive power having a convex object-side surface **231** and a convex image-side surface **232**, the object-side and image-side surfaces **231** and **232** thereof being aspheric; a plastic fourth lens element **240** with negative refractive power having a concave object-side surface **241** and a concave image-side surface **242**, the object-side and image-side surfaces **241** and **242** thereof being aspheric; and a plastic fifth lens element **250** with positive refractive power having a convex object-side surface **251** and a convex image-side surface **252**, the object-side and image-side surfaces **251** and **252** thereof being aspheric. Moreover, the wide-angle imaging lens assembly is provided with a stop **200** and an electronic sensor, the stop **200** is disposed between the second lens element **220** and the third lens element **230**, the electronic sensor is disposed at the image plane **290** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **260** and a cover-glass **270** sequentially disposed between the image-side surface **252** of the fifth lens element **250** and the image plane **290**; the IR-filter **260** and the cover-glass **270** are made of glass and have no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the second embodiment has the same form as that of the first embodiment.

In the second embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=1.19 (mm).

In the second embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.20.

In the second embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=84.1 deg. In the second embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **210** is V**1**, the Abbe number of the second lens element **220** is V**2**, and they satisfy the relation: V**1**−V**2**=31.3.

In the second embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **210** is f**1**, the focal length of the second lens element **220** is f**2**, and they satisfy the relation: f**1**/f**2**=0.94.

In the second embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **242** of the fourth lens element **240** is R**8**, the radius of curvature of the object-side surface **241** of the fourth lens element **240** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.75.

In the second embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **211** of the first lens element **210** is R**1**, the radius of curvature of the image-side surface **212** of the first lens element **210** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.83.

In the second embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **220** and the third lens element **230** is T**23**, the distance on the optical axis between the first lens element **210** and the second lens element **220** is T**12**, and they satisfy the relation: T**23**/T**12**=0.33.

In the second embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **240** on the optical axis is CT**4**, the radius of curvature of the image-side surface **242** of the fourth lens element **240** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.36.

In the second embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.46.

In the second embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **200** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **211** of the first lens element **210** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.51, TTL/ImgH=4.63.

The detailed optical data of the second embodiment is shown in FIG. **12** (TABLE 3), and the aspheric surface data is shown in FIG. **13** (TABLE 4), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **3**A shows a wide-angle imaging lens assembly in accordance with the third embodiment of the present invention, and FIG. **3**B shows the aberration curves of the third embodiment of the present invention. In the third embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a glass first lens element **310** with negative refractive power having a convex object-side surface **311** and a concave image-side surface **312**; a plastic second lens element **320** with negative refractive power having a convex object-side surface **321** and a concave image-side surface **322**, the object-side and image-side surfaces **321** and **322** thereof being aspheric; a plastic third lens element **330** with positive refractive power having a concave object-side surface **331** and a convex image-side surface **332**, the object-side and image-side surfaces **331** and **332** thereof being aspheric; a glass fourth lens element **340** with negative refractive power having a convex object-side surface **341** and a concave image-side surface **342**; and a glass fifth lens element **350** with positive refractive power having a convex object-side surface **351** and a convex image-side surface **352**; wherein the fourth lens element **340** and the fifth lens element **350** are adhered together to form a doublet lens. Moreover, the wide-angle imaging lens assembly is provided with a stop **300** and an electronic sensor, the stop **300** is disposed between the third lens element **330** and the fourth lens element **340**, the electronic sensor is disposed at the image plane **390** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **360** disposed between the image-side surface **352** of the fifth lens element **350** and the image plane **390**; the IR-filter **360** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the third embodiment has the same form as that of the first embodiment.

In the third embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=2.68 (mm).

In the third embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.8.

In the third embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=75.5 deg.

In the third embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **310** is V**1**, the Abbe number of the second lens element **320** is V**2**, and they satisfy the relation: V**1**−V**2**=36.5.

In the third embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **310** is f**1**, the focal length of the second lens element **320** is f**2**, and they satisfy the relation: f**1**/f**2**=0.13.

In the third embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **342** of the fourth lens element **340** is R**8**, the radius of curvature of the object-side surface **341** of the fourth lens element **340** is R**7**, and they satisfy the relation: R**8**/R**7**=0.21.

In the third embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **311** of the first lens element **310** is R**1**, the radius of curvature of the image-side surface **312** of the first lens element **310** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.24.

In the third embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **320** and the third lens element **330** is T**23**, the distance on the optical axis between the first lens element **310** and the second lens element **320** is T**12**, and they satisfy the relation: T**23**/T**12**=0.44.

In the third embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **340** on the optical axis is CT**4**, the radius of curvature of the image-side surface **342** of the fourth lens element **340** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.11.

In the third embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.96.

In the third embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **300** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **311** of the first lens element **310** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.50, TTL/ImgH=5.32.

The detailed optical data of the third embodiment is shown in FIG. **14** (TABLE 5), and the aspheric surface data is shown in FIG. **15** (TABLE 6), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **4**A shows a wide-angle imaging lens assembly in accordance with the fourth embodiment of the present invention, and FIG. **4**B shows the aberration curves of the fourth embodiment of the present invention. In the fourth embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a plastic first lens element **410** with negative refractive power having a concave object-side surface **411** and a concave image-side surface **412**, the object-side and image-side surfaces **411** and **412** thereof being aspheric; a plastic second lens element **420** with negative refractive power having a convex object-side surface **421** and a concave image-side surface **422**, the object-side and image-side surfaces **421** and **422** thereof being aspheric; a plastic third lens element **430** with positive refractive power having a convex object-side surface **431** and a convex image-side surface **432**, the object-side and image-side surfaces **431** and **432** thereof being aspheric; a glass fourth lens element **440** with negative refractive power having a concave object-side surface **441** and a concave image-side surface **442**; and a glass fifth lens element **450** with positive refractive power having a convex object-side surface **451** and a convex image-side surface **452**; wherein the fourth lens element **440** and the fifth lens element **450** are adhered together to form a doublet lens. Moreover, the wide-angle imaging lens assembly is provided with a stop **400** and an electronic sensor, the stop **400** is disposed between the third lens element **430** and the fourth lens element **440**, the electronic sensor is disposed at the image plane **490** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **460** disposed between the image-side surface **452** of the fifth lens element **450** and the image plane **490**; the IR-filter **460** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the fourth embodiment has the same form as that of the first embodiment.

In the fourth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=2.49 (mm).

In the fourth embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.80.

In the fourth embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=73.2 deg. In the fourth embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **410** is V**1**, the Abbe number of the second lens element **420** is V**2**, and they satisfy the relation: V**1**−V**2**=32.5.

In the fourth embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **410** is f**1**, the focal length of the second lens element **420** is f**2**, and they satisfy the relation: f**1**/f**2**=0.16.

In the fourth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **442** of the fourth lens element **440** is R**8**, the radius of curvature of the object-side surface **441** of the fourth lens element **440** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.13.

In the fourth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **411** of the first lens element **410** is R**1**, the radius of curvature of the image-side surface **412** of the first lens element **410** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=0.40.

In the fourth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **420** and the third lens element **430** is T**23**, the distance on the optical axis between the first lens element **410** and the second lens element **420** is T**12**, and they satisfy the relation: T**23**/T**12**=0.30.

In the fourth embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **440** on the optical axis is CT**4**, the radius of curvature of the image-side surface **442** of the fourth lens element **440** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.11.

In the fourth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.83.

In the fourth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **400** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **411** of the first lens element **410** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.46, TTL/ImgH=4.63.

The detailed optical data of the fourth embodiment is shown in FIG. **16** (TABLE 7), and the aspheric surface data is shown in FIG. **17** (TABLE 8), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. 5A shows a wide-angle imaging lens assembly in accordance with the fifth embodiment of the present invention, and FIG. 5B shows the aberration curves of the fifth embodiment of the present invention. In the fifth embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a glass first lens element **510** with negative refractive power having a convex object-side surface **511** and a concave image-side surface **512**; a plastic second lens element **520** with negative refractive power having a convex object-side surface **521** and a concave image-side surface **522**, the object-side and image-side surfaces **521** and **522** thereof being aspheric; a plastic third lens element **530** with positive refractive power having a convex object-side surface **531** and a convex image-side surface **532**, the object-side and image-side surfaces **531** and **532** thereof being aspheric; a plastic fourth lens element **540** with negative refractive power having a concave object-side surface **541** and a concave image-side surface **542**, the object-side and image-side surfaces **541** and **542** thereof being aspheric; and a plastic fifth lens element **550** with positive refractive power having a concave object-side surface **551** and a convex image-side surface **552**, the object-side and image-side surfaces **551** and **552** thereof being aspheric. Moreover, the wide-angle imaging lens assembly is provided with a stop **500** and an electronic sensor, the stop **500** is disposed between the second lens element **520** and the third lens element **530**, the electronic sensor is disposed at the image plane **590** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **560** and a cover-glass **570** sequentially disposed between the image-side surface **552** of the fifth lens element **550** and the image plane **590**; the IR-filter **560** and the cover-glass **570** are made of glass and have no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the fifth embodiment has the same form as that of the first embodiment.

In the fifth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=1.23 (mm).

In the fifth embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.20.

In the fifth embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=84.0 deg.

In the fifth embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **510** is V**1**, the Abbe number of the second lens element **520** is V**2**, and they satisfy the relation: V**1**−V**2**=31.3.

In the fifth embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **510** is f**1**, the focal length of the second lens element **520** is f**2**, and they satisfy the relation: f**1**/f**2**=0.91.

In the fifth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **542** of the fourth lens element **540** is R**8**, the radius of curvature of the object-side surface **541** of the fourth lens element **540** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.37.

In the fifth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **511** of the first lens element **510** is R**1**, the radius of curvature of the image-side surface **512** of the first lens element **510** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.83.

In the fifth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **520** and the third lens element **530** is T**23**, the distance on the optical axis between the first lens element **510** and the second lens element **520** is T**12**, and they satisfy the relation: T**23**/T**12**=0.29.

In the fifth embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **540** on the optical axis is CT**4**, the radius of curvature of the image-side surface **542** of the fourth lens element **540** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.39.

In the fifth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.47.

In the fifth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **500** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **511** of the first lens element **510** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.49, TTL/ImgH=4.53.

The detailed optical data of the fifth embodiment is shown in FIG. **18** (TABLE 9), and the aspheric surface data is shown in FIG. **19** (TABLE 10), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **6**A shows a wide-angle imaging lens assembly in accordance with the sixth embodiment of the present invention, and FIG. **6**B shows the aberration curves of the sixth embodiment of the present invention. In the sixth embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a plastic first lens element **610** with negative refractive power having a convex object-side surface **611** and a concave image-side surface **612**, the object-side and image-side surfaces **611** and **612** thereof being aspheric; a plastic second lens element **620** with negative refractive power having a convex object-side surface **621** and a concave image-side surface **622**, the object-side and image-side surfaces **621** and **622** thereof being aspheric; a plastic third lens element **630** with positive refractive power having a convex object-side surface **631** and a convex image-side surface **632**, the object-side and image-side surfaces **631** and **632** thereof being aspheric; a glass fourth lens element **640** with negative refractive power having a concave object-side surface **641** and a concave image-side surface **642**; and a glass fifth lens element **650** with positive refractive power having a convex object-side surface **651** and a convex image-side surface **652**; wherein the fourth lens element **640** and the fifth lens element **650** are adhered together to form a doublet lens. Moreover, the wide-angle imaging lens assembly is provided with a stop **600** and an electronic sensor, the stop **600** is disposed between the third lens element **630** and the fourth lens element **640**, the electronic sensor is disposed at the image plane **690** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **660** disposed between the image-side surface **652** of the fifth lens element **650** and the image plane **690**; the IR-filter **660** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the sixth embodiment has the same form as that of the first embodiment.

In the sixth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=3.06 (mm).

In the sixth embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.80.

In the sixth embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=77.8 deg.

In the sixth embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **610** is V**1**, the Abbe number of the second lens element **620** is V**2**, and they satisfy the relation: V**1**−V**2**=30.2.

In the sixth embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **610** is f**1**, the focal length of the second lens element **620** is f**2**, and they satisfy the relation: f**1**/f**2**=0.25.

In the sixth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **642** of the fourth lens element **640** is R**8**, the radius of curvature of the object-side surface **641** of the fourth lens element **640** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.18.

In the sixth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **611** of the first lens element **610** is R**1**, the radius of curvature of the image-side surface **612** of the first lens element **610** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.08.

In the sixth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **620** and the third lens element **630** is T**23**, the distance on the optical axis between the first lens element **610** and the second lens element **620** is T**12**, and they satisfy the relation: T**23**/T**12**=0.51.

In the sixth embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **640** on the optical axis is CT**4**, the radius of curvature of the image-side surface **642** of the fourth lens element **640** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.19.

In the sixth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=1.02.

In the sixth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **600** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **611** of the first lens element **610** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.46, TTL/ImgH=4.63.

The detailed optical data of the sixth embodiment is shown in FIG. **20** (TABLE 11), and the aspheric surface data is shown in FIG. **21** (TABLE 12), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **7**A shows a wide-angle imaging lens assembly in accordance with the seventh embodiment of the present invention, and FIG. **7**B shows the aberration curves of the seventh embodiment of the present invention. In the seventh embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising five lens elements, in order from an object side to an image side: a glass first lens element **710** with negative refractive power having a convex object-side surface **711** and a concave image-side surface **712**; a plastic second lens element **720** with negative refractive power having a concave object-side surface **721** and a concave image-side surface **722**, the object-side and image-side surfaces **721** and **722** thereof being aspheric; a plastic third lens element **730** with positive refractive power having a convex object-side surface **731** and a convex image-side surface **732**, the object-side and image-side surfaces **731** and **732** thereof being aspheric; a glass fourth lens element **740** with negative refractive power having a concave object-side surface **741** and a concave image-side surface **742**; and a glass fifth lens element **750** with positive refractive power having a convex object-side surface **751** and a convex image-side surface **752**; wherein the fourth lens element **740** and the fifth lens element **750** are adhered together to form a doublet lens. Moreover, the wide-angle imaging lens assembly is provided with a stop **700** and an electronic sensor, the stop **700** is disposed between the third lens element **730** and the fourth lens element **740**, the electronic sensor is disposed at the image plane **790** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **760** disposed between the image-side surface **752** of the fifth lens element **750** and the image plane **790**; the IR-filter **760** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the seventh embodiment has the same form as that of the first embodiment.

In the seventh embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=2.75 (mm).

In the seventh embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.40.

In the seventh embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=84.0 deg.

In the seventh embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **710** is V**1**, the Abbe number of the second lens element **720** is V**2**, and they satisfy the relation: V**1**−V**2**=42.7.

In the seventh embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **710** is f**1**, the focal length of the second lens element **720** is f**2**, and they satisfy the relation: f**1**/f**2**=1.13.

In the seventh embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **742** of the fourth lens element **740** is R**8**, the radius of curvature of the object-side surface **741** of the fourth lens element **740** is R**7**, and they satisfy the relation: R**8**/R**7**=−0.35.

In the seventh embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **711** of the first lens element **710** is R**1**, the radius of curvature of the image-side surface **712** of the first lens element **710** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.37.

In the seventh embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **720** and the third lens element **730** is T**23**, the distance on the optical axis between the first lens element **710** and the second lens element **720** is T**12**, and they satisfy the relation: T**23**/T**12**=0.81.

In the seventh embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **740** on the optical axis is CT**4**, the radius of curvature of the image-side surface **742** of the fourth lens element **740** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.11.

In the seventh embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.89.

In the seventh embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **700** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **711** of the first lens element **710** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.43, TTL/ImgH=5.77.

The detailed optical data of the seventh embodiment is shown in FIG. **22** (TABLE 13), and the aspheric surface data is shown in FIG. **23** (TABLE 14), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **8**A shows a wide-angle imaging lens assembly in accordance with the eighth embodiment of the present invention, and FIG. **8**B shows the aberration curves of the eighth embodiment of the present invention. In the eighth embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising six lens elements, in order from an object side to an image side: a glass first lens element **810** with negative refractive power having a convex object-side surface **811** and a concave image-side surface **812**; a plastic second lens element **820** with negative refractive power having a convex object-side surface **821** and a concave image-side surface **822**, the object-side and image-side surfaces **821** and **822** thereof being aspheric; a glass third lens element **830** with positive refractive power having a convex object-side surface **831** and a convex image-side surface **832**; a plastic fourth lens element **840** with negative refractive power having a concave object-side surface **841** and a concave image-side surface **842**, the object-side and image-side surfaces **841** and **842** thereof being aspheric; a plastic fifth lens element **850** with positive refractive power having a convex object-side surface **851** and a convex image-side surface **852**, the object-side and image-side surfaces **851** and **852** thereof being aspheric; and a glass sixth lens element **860** with positive refractive power having a convex object-side surface **861** and a concave image-side surface **862**, the sixth lens element **860** being disposed between the second lens element **820** and the third lens element **830**. Moreover, the wide-angle imaging lens assembly is provided with a stop **800** and an electronic sensor, the stop **800** is disposed between the sixth lens element **860** and the third lens element **830**, the electronic sensor is disposed at the image plane **890** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **870** and a cover-glass **880** sequentially disposed between the image-side surface **852** of the fifth lens element **850** and the image plane **890**; the IR-filter **870** and the cover-glass **880** are made of glass and have no influence on the focal length of the wide-angle imaging lens assembly.

The equation of the aspheric surface profiles of the eighth embodiment has the same form as that of the first embodiment.

In the eighth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=1.27 (mm).

In the eighth embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.82.

In the eighth embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=72.4 deg.

In the eighth embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **810** is V**1**, the Abbe number of the second lens element **820** is V**2**, and they satisfy the relation: V**1**−V**2**=4.5.

In the eighth embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **810** is f**1**, the focal length of the second lens element **820** is f**2**, and they satisfy the relation: f**1**/f**2**=3.02.

In the eighth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **842** of the fourth lens element **840** is R**8**, the radius of curvature of the object-side surface **841** of the fourth lens element **840** is R7, and they satisfy the relation: R**8**/R7=−3.92.

In the eighth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **811** of the first lens element **810** is R**1**, the radius of curvature of the image-side surface **812** of the first lens element **810** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=2.03.

In the eighth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **820** and the third lens element **830** is T**23**, the distance on the optical axis between the first lens element **810** and the second lens element **820** is T**12**, and they satisfy the relation: T**23**/T**12**=2.45.

In the eighth embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **840** on the optical axis is CT**4**, the radius of curvature of the image-side surface **842** of the fourth lens element **840** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.07.

In the eighth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.56.

In the eighth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **800** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **811** of the first lens element **810** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.42, TTL/ImgH=8.14.

The detailed optical data of the eighth embodiment is shown in FIG. **24** (TABLE 15), and the aspheric surface data is shown in FIG. **25** (TABLE 16), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

FIG. **9**A shows a wide-angle imaging lens assembly in accordance with the ninth embodiment of the present invention, and FIG. **9**B shows the aberration curves of the ninth embodiment of the present invention. In the ninth embodiment of the present invention, there is a wide-angle imaging lens assembly mainly comprising six lens elements, in order from an object side to an image side: a glass first lens element

910 with negative refractive power having a convex object-side surface **911** and a concave image-side surface **912**; a glass second lens element **920** with negative refractive power having a convex object-side surface **921** and a concave image-side surface **922**; a glass third lens element **930** with positive refractive power having a convex object-side surface **931** and a convex image-side surface **932**; a glass fourth lens element **940** with negative refractive power having a concave object-side surface **941** and a concave image-side surface **942**; a glass fifth lens element **950** with positive refractive power having a convex object-side surface **951** and a convex image-side surface **952**; and a glass sixth lens element **960** with positive refractive power having a convex object-side surface **961** and a convex image-side surface **962**, the sixth lens element **960** being disposed between the second lens element **920** and the third lens element **930**. Moreover, the wide-angle imaging lens assembly is provided with a stop **900** and an electronic sensor, the stop **900** is disposed between the sixth lens element **960** and the third lens element **930**, the electronic sensor is disposed at the image plane **990** for image formation of an object. The wide-angle imaging lens assembly further comprises an IR-filter **970** disposed between the image-side surface **952** of the fifth lens element **950** and the image plane **990**; the IR-filter **970** is made of glass and has no influence on the focal length of the wide-angle imaging lens assembly.

In the ninth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, and it satisfies the relation: f=1.70 (mm).

In the ninth embodiment of the present wide-angle imaging lens assembly, the f-number of the wide-angle imaging lens assembly is Fno, and it satisfies the relation: Fno=2.40.

In the ninth embodiment of the present wide-angle imaging lens assembly, half of the maximal field of view of the wide-angle imaging lens assembly is HFOV, and it satisfies the relation: HFOV=88.7 deg.

In the ninth embodiment of the present wide-angle imaging lens assembly, the Abbe number of the first lens element **910** is V**1**, the Abbe number of the second lens element **920** is V**2**, and they satisfy the relation: V**1**−V**2**=0.0.

In the ninth embodiment of the present wide-angle imaging lens assembly, the focal length of the first lens element **910** is f**1**, the focal length of the second lens element **920** is f**2**, and they satisfy the relation: f**1**/f**2**=0.91.

In the ninth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the image-side surface **942** of the fourth lens element **940** is R**8**, the radius of curvature of the object-side surface **941** of the fourth lens element **940** is R**7**, and they satisfy the relation: R**8**/R**7**=−1.46.

In the ninth embodiment of the present wide-angle imaging lens assembly, the radius of curvature of the object-side surface **911** of the first lens element **910** is R**1**, the radius of curvature of the image-side surface **912** of the first lens element **910** is R**2**, and they satisfy the relation: (R**1**+R**2**)/(R**1**−R**2**)=1.42.

In the ninth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the second lens element **920** and the third lens element **930** is T**23**, the distance on the optical axis between the first lens element **910** and the second lens element **920** is T**12**, and they satisfy the relation: T**23**/T**12**=6.03.

In the ninth embodiment of the present wide-angle imaging lens assembly, the thickness of the fourth lens element **940** on the optical axis is CT**4**, the radius of curvature of the image-side surface **942** of the fourth lens element **940** is R**8**, and they satisfy the relation: CT**4**/R**8**=0.12.

In the ninth embodiment of the present wide-angle imaging lens assembly, the focal length of the wide-angle imaging lens assembly is f, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: f/ImgH=0.75.

In the ninth embodiment of the present wide-angle imaging lens assembly, the distance on the optical axis between the stop **900** and the electronic sensor is SL, the distance on the optical axis between the object-side surface **911** of the first lens element **910** and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: SL/TTL=0.40, TTL/ImgH=8.31.

The detailed optical data of the ninth embodiment is shown in FIG. **26** (TABLE 17), wherein the units of the radius of curvature, the thickness and the focal length are expressed in mm, and HFOV is half of the maximal field of view.

It is to be noted that TABLES 1-17 (illustrated in FIGS. **10**-**26** respectively) show different data of the different embodiments; however, the data of the different embodiments are obtained from experiments. Therefore, any wide-angle imaging lens assembly of the same structure is considered to be within the scope of the present invention even if it uses different data. The embodiments depicted above and the appended drawings are exemplary and are not intended to limit the claim scope of the present invention. TABLE 18 (illustrated in FIG. **27**) shows the data of the respective embodiments resulting from the equations.

What is claimed is:

1. A wide-angle imaging lens assembly comprising, in order from an object-side to an image-side:

- a first lens element with negative refractive power having a convex object-side surface and a concave image-side surface;
- a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface;
- a third lens element with positive refractive power;
- a fourth lens element with negative refractive power having a concave image-side surface; and
- a fifth lens element with positive refractive power; wherein the number of lens elements with refractive power is five; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of an object; and wherein a focal length of the first lens element is f**1**, a focal length of the second lens element is f**2**, a distance on an optical axis between the second lens element and the third lens element is T**23**, a distance on the optical axis between the first lens element and the second lens element is T**12**, a radius of curvature of the image-side surface of the fourth lens element is R**8**, a radius of curvature of an object-side surface of the fourth lens element is R**7**, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, and they satisfy the relations: 0<f**1**/f**2**<2.00, 0.15<T**23**/T**12**<0.69, −1.40<R**8**/R**7**<0.70, 0.40<f/ImgH<1.10.

2. The wide-angle imaging lens assembly according to claim **1**, wherein the fifth lens element has a convex object-side surface and a convex image-side surface.

3. The wide-angle imaging lens assembly according to claim **1**, wherein a radius of curvature of the object-side surface of the first lens element is R**1**, a radius of curvature of the image-side surface of the first lens element is R**2**, and they satisfy the relation: 1.03<(R**1**+R**2**)/(R**1**−R**2**)<3.00.

4. The wide-angle imaging lens assembly according to claim 3, wherein the second lens element is made of plastic material and having at least one of the surfaces thereof being aspheric.

5. The wide-angle imaging lens assembly according to claim 3, wherein the focal length of the first lens element is fl, the focal length of the second lens element is f2, and they satisfy the relation: $0<f1/f2<1.20$.

6. The wide-angle imaging lens assembly according to claim 3 further comprising a stop disposed between the second lens element and the fourth lens element, wherein a distance on the optical axis between the stop and the electronic sensor is SL, a distance on the optical axis between the object-side surface of the first lens element and the electronic sensor is TTL, and they satisfy the relation: $0.30<SL/TTL<0.65$.

7. The wide-angle imaging lens assembly according to claim 1 comprising at least one lens element having at least one aspheric surface.

8. The wide-angle imaging lens assembly according to claim 7, wherein an Abbe number of the first lens element is V1, an Abbe number of the second lens element is V2, and they satisfy the relation: $20<V1-V2<50$.

9. The wide-angle imaging lens assembly according to claim 1, wherein the fourth lens element has a concave object-side surface.

10. The wide-angle imaging lens assembly according to claim 1, wherein the fourth lens element and the fifth lens element are adhered together to form a doublet lens element.

11. The wide-angle imaging lens assembly according to claim 1, wherein the distance on the optical axis between the object-side surface of the first lens element and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: $TTL/ImgH<8.6$.

12. The wide-angle imaging lens assembly according to claim 11, wherein the distance on the optical axis between the object-side surface of the first lens element and the electronic sensor is TTL, half of the diagonal length of the effective pixel area of the electronic sensor is ImgH, and they satisfy the relation: $TTL/ImgH<6.0$.

13. A wide-angle imaging lens assembly comprising, in order from an object-side to an image-side:

a first lens element with negative refractive power having a concave image-side surface;

a second lens element with negative refractive power having a concave image-side surface;

a third lens element with positive refractive power;

a fourth lens element with negative refractive power; and

a fifth lens element with positive refractive power; wherein the wide-angle imaging lens assembly is further provided with a stop and an electronic sensor, the stop is disposed between the second lens element and the fourth lens element, the electronic sensor is disposed at an image plane for image formation of an object; wherein the number of lens elements with refractive power is five; and wherein a focal length of the first lens element is f1, a focal length of the second lens element is f2, a distance on an optical axis between the stop and the electronic sensor is SL, a distance on the optical axis between an object-side surface of the first lens element and the electronic sensor is TTL, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, a focal length of the wide-angle imaging lens assembly is f, and they satisfy the relations: $0<f1/f2<1.20$, $0.20<SL/TTL<0.85$, $TTL/ImgH<8.6$, $0.40<f/ImgH<1.10$.

14. The wide-angle imaging lens assembly according to claim 13, wherein a radius of curvature of the object-side surface of the first lens element is R1, a radius of curvature of the image-side surface of the first lens element is R2, and they satisfy the relation: $1.03<(R1+R2)/(R1-R2)<3.00$.

15. The wide-angle imaging lens assembly according to claim 14, wherein a radius of curvature of an image-side surface of the fourth lens element is R8, a radius of curvature of an object-side surface of the fourth lens element is R7, and they satisfy the relation: $-1.40<R8/R7<0.70$.

16. The wide-angle imaging lens assembly according to claim 14, wherein the object-side and image-side surfaces of the fourth lens element are both concave.

17. A wide-angle imaging lens assembly comprising, in order from an object-side to an image-side:

a first lens element with negative refractive power having a concave image-side surface;

a second lens element with negative refractive power having a convex object-side surface and a concave image-side surface;

a third lens element with positive refractive power;

a fourth lens element with negative refractive power having a concave image-side surface; and

a fifth lens element with positive refractive power; wherein the number of lens elements with refractive power is five; wherein the wide-angle imaging lens assembly is further provided with an electronic sensor for image formation of an object; and wherein a thickness of the fourth lens element on an optical axis is CT4, a radius of curvature of the image-side surface of the fourth lens element is R8, a focal length of the wide-angle imaging lens assembly is f, half of a diagonal length of an effective pixel area of the electronic sensor is ImgH, a focal length of the first lens element is f1, a focal length of the second lens element is f2, and they satisfy the relations: $0<CT4/R8<0.70$, $0.04<f/ImgH<1.10$, $0<f1/f2<1.20$.

18. The wide-angle imaging lens assembly according to claim 17, wherein a radius of curvature of the object-side surface of the first lens element is R1, a radius of curvature of the image-side surface of the first lens element is R2, and they satisfy the relation: $1.03<(R1+R2)/(R1-R2)<3.00$.

19. The wide-angle imaging lens assembly according to claim 17, wherein the fourth lens element has a concave object-side surface.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,654,458 B2
APPLICATION NO. : 12/978996
DATED : February 18, 2014
INVENTOR(S) : Tsung Han Tsai

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 24, Claim 17, Line 47, the right-hand formula should appear as follows:

$0<CT4/R8<0.70$, $0.40<f/ImgH<1.10$, $0<f1/f2<1.20$.

Signed and Sealed this
Thirtieth Day of December, 2014

Michelle K. Lee

Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office